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SECURING DISEASE RESISTANT PLANTS: HOW IMPORTANT IS IT? WHOSE JOB IS IT?[1]

THE rapid professional development of plant pathology in the United States is a unique thing in the history of applied botany. European mycologists who visit us wonder at it and query why it has not occurred in the father lands. This is the more noteworthy when we recall that the mycological foundations of phytopathology were laid in Germany and the most stimulating early control measures came from France. To one who has followed the developments of agricultural science in the American states, especially as represented in the history of the Department of Agriculture and the state experiment stations, the answer is obvious. Almost simultaneously with the inauguration of these in the late 80's we were handed from Europe, ready for our use, new chemical compounds which, as sprays or seed disinfectants, were "specifics" against those age-old pests, the blights, mildews and smuts. Since the dawn of recorded history man had suffered almost helplessly from their toll. Now for the first time modern science had given him effective means for fighting these maladies. The public—shall we say the American public especially—is always eager to have its ills cured by "specifics," especially if it can get them in handy bottles or packets. We are even told that this mental attitude explains our many laws, among them legal restrictions concerning the sale of "patent medicines" and "dopes." These "specific" sprays and seed treatments seemed almost like the magic wand. As the inevitable result, the agricultural public, and perhaps some of us pathologists, have naturally developed an exaggerated notion as to the relative importance of spraying and disinfection in the control of crop plant diseases. Please do not misunderstand me. Never, since our agricultural experiment station movement began, has progress been more rapid in the perfection of fungicides than in recent years, and they should be, and will be, used even more in the immediate future than ever before. But at the same time the relative emphasis on control methods in plant pathology is passing more and more to disease resistance.

We may check, in part, the smut and bunt of wheat by seed treatment, but what about the seedling blight

[1] Address of retiring vice-president and chairman of Section O (Agriculture), American Association for the Advancement of Science, Kansas City, December 31, 1925.

and rust? We may check, in part, potato blight by Bordeaux mixture, but what about the virus plagues? We may check, in part, apple scab with lime-sulfur but what about fire blight? And, even where we can secure commercial control by such specific remedies, they are, as a rule, not only an expensive tax that only the crop specialist can afford to pay, but they are mere temporary palliatives, an annual tax to be paid in perpetuity. Improvements in fungicides and their use should continue wherever intensive agriculture is practiced, but the search for disease-resistant crops merits more attention as of increasing relative importance. As illustrating these things from a single field we may note the fact, familiar to all American agronomists, that although refinement in seed treatment methods has rarely been more active than to-day, our interest in this is overshadowed by the hopes justified from the progress with cereal strains resistant to smuts and seedling blights as well as to the dreaded rusts and the even more baffling virus diseases.

If we subscribe to the relative significance of these facts and agree that the urgent need is for disease resistant strains, not of one but of all important crop plants, let us frankly face the challenging question: Whose business is it to find or develop these?

But do we really sense this challenge? A generation ago the French vineyardists were forced to. The ravages of the Phylloxera obliged them literally to remake their vineyards on resistant roots. In general, American plant culturists are facing no such crises. But in a limited way I have seen such a local crisis with one crop plant, the cabbage. And just as in France the remade vineyards on resistant roots surpass the older, we may confidently predict that the new American cabbage industry is to have not only disease-resistant strains of all the various needed types, but, thanks to the devoted skill of my younger associate, Dr. J. C. Walker, these strains will average better and more uniform than American growers have ever before known. If we accept this challenge and clearly define the responsibilities before us, does it mean anything less than a similar reworking and in a sense remaking of all our crop plant varieties? Such an undertaking is too great for any single class or group of plant culturists. If it is to proceed apace we must collectively face the task and severally do our part. That we may do this more intelligently, let us try to define what such part may be.

In the first place, let us not think of the task as too remote. Disease resistant plants are all about us awaiting detection. Variations as to relative susceptibility, or conversely, as to relative resistance to disease, occur as commonly as do variations in other characteristics. Indeed, with our cultivated plants we may expect such variations to be quite as common in relative disease resistance as in color or other more readily observable characters. Plant breeders have long since selected and fixed type with a fair degree of uniformity as to these more obvious things. But as to disease susceptibility or resistance in this new hemisphere, neither natural selection nor that of man has had time to operate as effectively as it has in the corresponding old world fields and gardens. As a rule, we may assume that the initial difficulty is not as to the existence of such resistant plants but in the finding of them.

If we accept these facts, then it should be evident why too much reliance must not be put on any single group of workers. While any effort for correlated apportionment of responsibility in research is worse than useless if conceived in a spirit of inhibition it may be most helpful if it indicates natural lines of progress. The professional groups with whom responsibility rests for finding or developing disease-resistant plants may be listed, perhaps in order of natural responsibility, as (1) the plant pathologists, (2) the geneticists, (3) the plant culturists whether from the field of horticulture or of agronomy. Let us consider the relative responsibility of each and ask whether collectively they are equal to the task.

WHOSE JOB IS IT?

I. The plant pathologist's, of course, in part, but only in part! And what is his evident share?

(1) His is the chief responsibility for defining and emphasizing the need. This is the more obviously his duty because heretofore he has talked more often of the easier temporary remedies.

(2) His must be the duty of leading in the study of the nature and cause of disease resistance; also of the associated complexes—the relation of environment to predisposition and to resistance. Such problems obviously require the technic, the continued interest and the familiarity with pathological details which only the phytopathologist may be expected to have.

(3) His may also be an important share in learning through observation and experiment what are the relative merits of recognized varieties as to disease resistance. This is especially his responsibility when his technical skill is needed to differentiate closely similar diseases (*e.g.*, with cabbage yellows vs. black rot) and even more so when specialized races of the parasites must be differentiated (*e.g.*, stem rusts of cereals, bean anthracnose).

(4) A lesser, though important, share in the search for disease-resistant individuals. This should largely be restricted to the selection from existing varieties rather than through breeding. Moreover, it should

be primarily concerned with those diseases which are receiving his special consideration from the pathological standpoint as contrasted with a diffused or general responsibility.

(5) A still less share should be his in the perfecting of resistant strains through hybridization. Exceptionally this fascinating work may be his privilege or even his clear duty. But I would emphasize that this is to be the exception rather than the rule lest the plant pathological profession divert too much service from its own proper field to one where its training and efficiency may count for less. Where local conditions and associations favor, such breeding responsibilities should, I believe, be left for the plant culturist or the geneticist.

In any case, the plant pathologist may thus rightly be expected to meet only a moderate share of the evident needs in the development of resistant crop plants.

II. The plant geneticist also in part, but only in part! And what is his share?

(1) Certainly it is his opportunity and responsibility to take the lead in defining the genetical methods to be used in such work and in discovering the genetical laws involved in the inheritance of the factors of disease resistance.

(2) Of course he should also, in many cases, lead in correlated efforts with plant pathological or plant cultural associates in advancing specific disease-resistant breeding efforts to a successful conclusion. This is especially true when the methods involve hybridization as supplementing selection. The gain from such correlated efforts has recently been admirably exemplified at Cornell with bean problems, also with wheat-rust problems in Minnesota and with the cereal-seedling-blight resistance program headed by the federal Office of Cereal Investigations, cooperating with several of the north central states.

But here again, as with plant pathologists, the professional group is too small and its members too busy with problems primarily of a different sort to justify reliance upon the geneticists as a professional group for any more than a small part in meeting the practical needs for disease-resistant plants.

III. What is the share of the plant culturist, whether from the field of horticulture or of agronomy?

Is it not evident that this group should take an increasingly large share of responsibility for the work? Naturally the early initiative and the pioneering as to principles and methods have rested with the more limited numbers of specialists and these chiefly in the fields of plant pathology and genetics. But when the principles and methods are defined, should not the opportunity and the duty for more of the detailed work pass to the hands of the professional plant culturists? This seems obvious for two reasons.

First, the number of workers and the nature of their occupation insures that the amount of plant material which passes under the survey of this group is much greater than that for either of the preceding professional groups.

Second, the "finished product" can only be secured by the long-continued attention of the trained plant culturist whose professional interest as well as individual skill enables him to secure, in combination with disease resistance, all those other qualities essential for the commercial success of the particular crop plant concerned.

It is only as the plant culturists assume such increasing share of responsibility that the needs for disease-resistant crop plants are adequately to be met from the professional ranks.

But even if the responsibilities are rightly defined as above and even if they are proportionately assumed by pathologists, geneticists and plant culturists, what then? Will our three professional groups thus by coordinated effort be equal to the task? Let me ask each of you individually and each group collectively, how much spare time have you for such new tasks? Let us realize, moreover, that such search for disease-resistant plants and, even more, such efforts at their production or improvement by hybridizing, is not for the weary or listless hand. The initiative for such developments can not be expected from the dull or work-fagged mind. Here, if anywhere in the field of scientific production, must the keenest intellects be operative, and full success is only assured to these who are at once clear in concept and tenacious of purpose; who are ready by persistent work and sustained thinking to follow their leads to the finish.

Let us also note that especially in this problem is the old adage true, "well begun is half done." The essential initial step is finding the first plant of outstanding disease resistance. Here again, let us note that there are two widely different sources from which this plant may come. The first, as with chestnut canker and pear blight, is in distant lands. For such search special exploring agents must be sent, *e.g.*, a Carleton to Russia for rust-resistant wheat, a Meyer to China for blight-resistant chestnuts, both financed by federal grants; or a Reinking to the Orient for wilt-resistant bananas, representing corporate interests. Such an agent may be selected, now from one professional group, now from another, as determined by the detailed needs and especially by personal fitness.

But such foreign exploring, although of spectacular interest in exceptional cases, is a minor matter when compared with the searching needed for nearby things. All about us in field, in garden, in orchard, are our chief possibilities. Even with the foreign introductions, the real "finds" must come from later

selections. It is in the hunt for these rare plants that many keen searchers are needed. How much help may rightly be expected in this from non-professional plant cultivators, including the amateur and the commercial groups, as supplementing that from the professional ranks?

AMATEUR AND COMMERCIAL CONTRIBUTIONS

A review of what has been done in plant as well as animal breeding leads one to marvel at the progress made. No one can fail to recognize that such cereals as wheat and rice, such fruits as apple and peach, such vegetables as cauliflower and lettuce, are the products of a high order of creative genius working through long ancestral generations. While the history of most of these is lost in antiquity we are fortunate enough in America to have witnessed similar developments with some of our new world plants. Let us not forget our debts to Ephraim Bull for the Concord grape and to Chauncey Goodrich for his pioneer potato breeding! How much we owe, indeed, to a score of searchers for hardy seedling apples adapted to our northern climate. How many of you have had personal contact with such amateur plant breeders? Those who have will, I am sure, bear witness with me to the fact that often we may find among them a very high type of native ability combined with a lifelong zeal and devotion to a single line of work. I can not forget my contacts with Cyrus Guernsey Pringle, than whom America has produced no keener student of plants afield. He is known to the older generation of eastern taxonomists as a plant collector whose field acquaintance with the native North American flora probably never has been equalled and indeed may never be again; "facile princeps" was the rank accorded him by his lifelong friend and counselor, Asa Gray. But for a decade in his early life Pringle was an amateur plant breeder, and his accomplishments in the seventies include improved wheats still in use, the hull-less oat and potatoes of the finest quality. Because of family misfortunes he soon left home to become a nation-wide collector, but he passed on his breeding stocks, together with some of his skill and enthusiasm, to his nephew, Frederick Horsford, who soon gave us the Horsford pea, while other Vermont neighbors, inspired by his example, produced the Nott's Excelsior pea and the Green Mountain potato. Still others in those remote Vermont valleys early worked with potato and one of them, Albert Bresee, produced what may perhaps be considered the most remarkable potato America has known, the Early Rose, important not only because a favorite in culture for two generations, but even more because it in turn has been the progenitor of much that is best in later seedling stocks in this country and even in Europe. The point I would emphasize by these illustrations, from limited personal acquaintance in one community, is that some of our rarest native creative ability, that which combines the keenest powers of observation, analysis and syntheses, may find its natural opportunity for expression in amateur plant breeding. Nor need we think that the understanding of the present knowledge of the laws of inheritance is beyond such men. Indeed, Pringle, while yet a young man, was so keen a student that, although home cares kept him from a college education, he acquired a botanical library adequate for his current needs and had stimulating correspondence with many other leading plant breeders, English and French as well as American. The mastery of modern genetical laws would have been only an added challenge to such a mind. When evaluating the place of the "amateur" in biological investigation may we not well remember that Charles Darwin was an amateur; and how about Gregor Mendel? Indeed, from my limited observation I wonder whether lack of recognition of the importance of the amateur in plant breeding is not merely modern American professional provincialism. Is it, perhaps, naturally associated with the recent rapid development of publicly supported agricultural institutions? Apparently there is no comparable situation in Europe. During this generation, when in America we have been losing the amateur in potato breeding, just when we most needed him to aid in the search for disease-resistant varieties, steady progress has been continuing with his aid in England and Germany. Through their national potato societies with competitive trials, annual shows and reports, these countries, relying chiefly on their amateur potato breeders, have so stimulated and rewarded them that they are at least a generation ahead of us in the development of disease-resisting strains of high and varied commercial qualities.

Most American amateurs have wrought for personal satisfaction rather than financial reward, but let us not forget that much that is good in American plant improvement has come from the stimulus, if not by the personal skill, of commercial seedsmen. Notably is this true in American bean improvements under the leadership of the Keeneys and Rogers. Creative ability is not necessarily or wisely divorced from ability to secure commercial rewards as evidenced by our Edisons and Westinghouses.

It might at first seem that such complex or obscure characters as are involved in disease resistance would evade the amateur. As a matter of fact, however, the expression of disease resistance may be obvious to any keen observer regardless of technical skill in phytopathology. Let us illustrate from recent de-

velopments with two crop plants, the bean and wheat, each of which has received especial attention from professionals skilled in both pathology and genetics.[2]

With the bean, our practical progress to date in developing disease-resistant strains is based upon the chance discovery of two basic types by men who were neither pathologists nor geneticists. I refer to the anthracnose-resistant strain, the Wells Red Kidney, found in his fields by a New York bean grower, Luce, (later grown by Wells), and the comparably chance discovery of the first mosaic-resistant Robust bean plant by Spragg, of the horticultural staff of Michigan Agricultural College. Although we may flatter ourselves by the thought that Professor Spragg was a member of our professional group we should recall that neither he nor any one else knew bean mosaic when he made that "find" in 1908. This "robust" plant was selected for general vigor and yield rather than for recognized disease resistance.

In the search for wheat resistant to the stem rust, unless I am mistaken, the strains of outstanding promise to date are the Kanred and the Webster. The Kanred came from selections originating with an imported Crimean wheat and continued by the Kansas College staff a decade before its rust-resistant character was defined. The Webster descended from another strain of Russian wheat introduced by the U. S. Department of Agriculture in 1913. This was of so unpromising a type that it was not even given a name until a seed grower, E. S. McFadden, of Webster, South Dakota, chanced to observe its rust-resisting character. Stakman[3] and associates, in following up this lead, find that the Webster wheat is "resistant to more physiologic forms of *Puccinia graminis tritici* than any other common wheat yet tested in the United States," and that it may be correspondingly "potentially valuable as a parent of rust-resistant hybrids."

The moral seems to me obvious, not that we of each professional group should do less, but that after doing all that is rightly possible, we should clearly recognize, define and advertise the need for help from others, including the amateur and commercial groups.

But, having thus portioned responsibility, let us in closing again emphasize that any suggestion of such division of the field or sharing of the tasks is worse than useless and may be positively harmful if conceived in a spirit of inhibition. Individual initiative and personal freedom must always be stimulated rather than suppressed. It is here that we need constantly to recognize the artificiality of our academic departmental lines. Not only should the aid of the amateur be welcomed by our professional groups, but within our professional ranks we must encourage the amateur spirit not merely as exemplified by enthusiastic devotion of purpose but also as concerns freedom to follow the natural leads of the problem. The finding of a disease-resistant plant by the horticulturist or the geneticist must bring opportunity with responsibility for continuing attention to the associated pathological questions as well as to those distinctively genetical or horticultural. Similarly, if the initiative is from the pathologist, he must give earnest attention to the genetical and cultural aspects if his contributions are to be at once fundamentally sound and practically worth-while. The methods of correlation must vary with each case. Ideally it may seem the commendable thing for two or three men representing specialized groups to work in association. Practically I believe the preferable way is for the one who initiates the work to carry it as far as he may, regardless of professional relations. If he starts as a plant culturist, whether professional or amateur, let him be encouraged and personally aided by pathological or genetical associates to penetrate and work in their field as far as justified by the natural trends of the problem and his ability to follow these. The spirit of research must not be restrained by the artificial bounds of professional or administrative classifications. The only criteria should be the genius to initiate and the ability for sustained progress in a natural course. In this way is the conquest of nature to proceed with disease resistance as with every other type of scientific endeavor.

L. R. JONES

UNIVERSITY OF WISCONSIN

[2] It may not be inappropriate to add that the case of Fusarium resistant cabbage, to which we have given especial attention, might also be cited. Our own findings of disease resistance in cabbage were antedated by two horticulturists, and at least one practical grower. They did not, however, know the nature of the disease and confused it with the bacterial black rot.

[3] Stakman, E. C., Levine, M. N., and Griffee, F. Webster, a common wheat resistant to black stem rust. *Phytopath.*, *15*: 691, 1925.

CHEMISTRY AND PURE SCIENCE[1]

THE wide field embracing the so-called natural sciences, ever broadening, ever extending its frontiers, may be conveniently and somewhat indefinitely divided into two general areas. One of these areas includes the descriptive sciences, and the other the explanatory sciences.

A descriptive science deals with the problem of investigating and describing various objects or phenomena as they occur in nature, while it is the aim

[1] Address delivered on the occasion of the dedication of Venable Hall of Chemistry, at the University of North Carolina.

of explanatory science to investigate the genesis, the inter-relations and the transformations which spontaneously appear or can be produced artificially, and to endeavor to discover the causes of these changes.

To quote from Mellor:

> It is the popular belief that the aim of science is to explain things; as a matter of fact, the so-called explanations of science do not get much beyond describing the observed facts in the simplest possible terms so as to make their relations with one another clear and intelligible.
>
> Science may explain a phenomenon by describing how one event is determined by an antecedent action—sometimes called a cause; and how one particular set of conditions—the cause—can give rise to another set of conditions—the effect. Science explains a phenomenon (the effect) by showing that it is a necessary or rather a probable consequence of another phenomenon (the cause).

If we attempt to assign any given branch of science to either the descriptive or the explanatory region of the general field we meet with difficulties which at once become apparent, for there is practically none that is wholly descriptive and none that is wholly explanatory. That this difficulty of classification should exist is apparent from the very nature of science itself, for, to quote Huxley:

> All true sciences begin with empirical knowledge—the record of facts obtained by observation and experiment.
>
> It is work for the intellect to educe the elements of sameness amidst apparent diversity, and to see differences amidst apparent identity.

In other words all science begins with facts and ends with laws.

Chemistry, therefore, can be expected to offer no exception to the general rule, for it is man's attempt to classify his knowledge of all the different constituents which compose the natural objects in the universe. It is therefore a fundamental portion of descriptive science. But it is—moreover—an explanatory science, since it attempts also to afford an explanation of the phenomena which occur when the different kinds of material react one with another. It strives also to give an insight into, and an understanding of, the very constitution of matter itself—something at present entirely, and probably forever, beyond the direct grasp of our senses. In all cases it has been necessary to first investigate that which is visible and subject to direct observation by the organs of the senses and then to develop hypotheses or propositions as to the actual causes and the true nature of the relations which have been observed between that which has been studied and the categories of time, space, movement or mass. It has further been necessary to verify the logical consequences of these hypotheses by experiment, and to advance theories which shall account for the nature of the properties of the thing studied in its relations with things already known, and with those conditions or categories among which it exists. And finally it has been necessary to keep clearly in mind a fact which is far too often overlooked or forgotten; a hypothesis or a theory can neither be proved or disproved. To quote the words of Ostwald, "It is merely a tool which is rejected when found to be no longer serviceable."

To briefly recapitulate we may therefore say that chemistry is the science which investigates and describes the various materials of which all natural objects are composed; it attempts to explain their actions toward other substances by indicating the causes of their behavior, and it offers hypotheses and theories to explain the behavior of substances when the causes are not directly perceptible to the organs of sense.

The more advanced developments of chemistry are indistinguishable from the science of physics and no dividing line can be drawn between the distinctive fields of these two important branches of natural science.

If we attempt to distinguish between a pure and an applied science we encounter difficulties which are even more formidable than those met with in an effort to distinguish between a descriptive science and an explanatory science, or to distinguish properly between physics and chemistry. "Pure" science may be defined as knowledge sought solely for the sake of truth, and applied science as knowledge utilized in the practice of the various arts. But if we go back to the earliest authorities and consult Plato and Aristotle we may be somewhat embarrassed to find it explicitly stated that—"It is the purpose of pure science to observe phenomena and trace their laws; the purpose of art to produce, modify or destroy. Strictly speaking there is no such thing as applied science, for, the moment the attempt is made to apply, science passes into the realm of art."

Since my thesis is the relation of chemistry to pure science I am in no way embarrassed by such a summary elimination of a topic which it is the duty of others to defend. But such an elimination in no way accords with the profound regard and respect which is felt by all for applied chemistry as a most potent factor in alleviating the suffering and improving the lot of mankind.

The contributions of chemistry to pure science in the strictest sense of the term have been so conspicuous and so great as to require neither enumeration nor emphasis. A list of the names of eminent chemists would be a list of conspicuous contributors to the

advancement of science in its purest form. Lavoisier, Dalton, Davy, Berzelius, Bunsen, Van't Hoff, Arrhenius, Victor Meyer, Crookes, Remsen, Venable—their names are many and they have labored for the truth in science and for the truth alone.

To cite a conspicuous example, because of his notable genius and because of the fact that, being associated with the university at which I was at that time a student, it was my privilege and pleasure to have known him—I will refer to Josiah Willard Gibbs. Gibbs contributed more than any other scientist to the elucidation of some of the most complex problems in theoretical chemistry. He was a pure scientist if there ever was one. He was absolutely impractical and the application of his science to a practical problem of production would have been for him an utter impossibility. To him the pursuit of knowledge was an abstraction, something to be followed for the sake of the knowledge alone, without any ulterior view to its ultimate application. His studies were so abstruse and apparently intangible that he was understood by but few, if any, of his contemporaries and by only a small proportion of his more advanced students. But the value of his contributions to the realm of chemistry is well-nigh incalculable and his name is achieving the eminence to which it is entitled.

But although Gibbs and the many others who have added much to pure science through the medium of chemistry are dead—the progress in these directions will continue and new hands will bear the torches into the dark places.

It is in the realization of such dreams as the construction of this splendid laboratory which we are today dedicating that assures the fulfilment of the promise of the future, and, in closing, I will quote to you a remark once made to me by Willard Gibbs, which emphasizes an idea that may well serve as a guiding principle in scientific inquiry:

> Nature is like a sphynx of whom we are forever asking questions. The answer she gives does not depend so much on the questions we ask as it does on the way we ask our questions.

B. B. BOLTWOOD

YALE UNIVERSITY

OPENING OF THE ASTRONOMIC HALL OF THE AMERICAN MUSEUM

ON March 24, 1926, a reception was held at the American Museum of Natural History in celebration of the opening of the preliminary astronomical hall. Included in the exhibits are oil paintings of the three solar eclipses seen in the United States in 1918, 1923 and 1925.

These eclipse paintings were begun through the engagement of Mr. Howard Russell Butler, N.A., by Mr. Edward Dean Adams, to paint the solar eclipse of June 8, 1918, at the station of the U. S. Naval Observatory at Baker, Oregon, and the gift of this painting to the American Museum. A physicist by early training and an artist by life training, Mr. Butler is probably the best qualified man in this country, if not in the world, to undertake the painting of this astronomical phenomenon which lasts at most only a very few minutes.

The paintings are arranged in the form of a triptych, and one sees the paintings as he would view the eclipses, each through a separate window. The lights are hidden so that the pictures appear to be large photographic transparencies in their true color.

The picture on the left of the triptych is of the total eclipse of the sun, which occurred on June 8, 1918, as seen by Mr. Butler at Baker, Oregon. The eclipse reached totality at 4:03 P. M. at an altitude of about 45°, and since it was in the afternoon the long axis of the corona was inclined to the right. The time was near the period of maximum sun-spots, and as was to be expected there was a diminished corona not exceeding three fourths the diameter of the sun, but with more polar streamers than were expected. The prominences, especially those on the lower right, reached exceptionally large proportions, the "Heliosaurus" measuring 47,000 miles in height. The "Eagle" at the top was another large and striking prominence. The eclipse was seen through a thin film of clouds, so thin that it did not appreciably lessen its brilliancy, but added to the picturesque effect. (Gift of Mr. Edward Dean Adams to the American Museum of Natural History.)

The vertical picture in the center of the triptych is of the total eclipse of the sun, which occurred on September 10, 1923, as seen near Lompoc, California. This eclipse reached totality at 12:59 P. M. and since it was almost a noon-day eclipse, the long axis of the corona was practically horizontal. The time was nearer the period of minimum sun-spots, and as was to be expected the corona was more extended. It was seen in a gap between two clouds. Mr. Butler, having practically finished his notes during the period of totality, was surprised by the first Baily's bead of the third contact, that is, the first appearance of a speck of the photosphere, evidently between two volcanic peaks on the rough surface of the moon. This appeared like an orange ball of great brilliancy resting on the upper limb of the moon. For a few seconds the corona remained, and Venus, slightly more than one degree above the moon, continued to shine brilliantly. He concluded to make this combined effect, commonly known as the diamond-ring effect, his pic-

ture. (Gift of the Morris K. Jessup Fund to the American Museum of Natural History.)

The picture on the right of the triptych is of the total eclipse of the sun, which occurred on January 24, 1925, as seen at Middletown, Connecticut. The eclipse reached totality at 9:10 A. M., and consequently the long axis of the corona is inclined to the left. The time was near the period of maximum sunspots, and not only was the outline of the corona surprising to astronomers, but some of the streamers were much longer than was expected. The prominences, while many (19 were recorded by the camera), were so small that they could not be seen by the naked eye. (Gift of the Morris K. Jessup Fund to the American Museum of Natural History.)

Besides the paintings of the eclipses, two other pictures by Mr. Howard Russell Butler were exhibited. Mr. Butler has painted a lunar landscape with the cooperation of Professor Henry Norris Russell, director of the Halsted Observatory at Princeton. It shows the earth in the sky as seen from the moon, the observer being located in one of the rugged lunar craters near a spine thrust up from the crater floor, similar to that which was formed during the great eruption of Mt. Pelée on Martinique in 1902. The earth is represented as in the month of June with the Atlantic toward the observer. It is passing through the constellation Scorpio, Antares appearing near the point of the spine. Mars is seen near the top of the canvas. (Gift of the Morris K. Jessup Fund to the American Museum of Natural History.) Mr. Butler's second picture represents the great aurora of August 12, 1919, as seen from Ogunquit, Maine.

In an outer alcove of the hall are a large number of photographic transparencies representing solar eclipses and other astronomical phenomena. These preliminary exhibits represent the first example of American Museum methods of education applied to astronomy and just outside of the hall are exhibited for the first time plans for the proposed hall of astronomy.

CLYDE FISHER
AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK CITY

FILIBERT ROTH

FILIBERT ROTH, professor emeritus and founder of the forestry department at the University of Michigan, has passed away. Professor Roth's life was that of a pioneer worker. In his life he combined Europe's best scientific ideals in forestry with an American frontiersman's conviction in the momentousness of his subject. He was representative of the early educator in his field.

Professor Roth was born in Wurtemburg, Germany, April 20, 1858, and came to the United States in 1871. His first years in this country in Wisconsin and later on western plains formed a rich background for his later efforts. It was his early impressions of the Lake States' white pine areas in Wisconsin which served as a foundation for his masterly knowledge of American forest conditions.

Graduating from the University of Michigan in 1890, almost immediately Professor Roth worked as special timber expert with the Bureau of Forestry. There he first became identified prominently with all forest developments in this country, and his work with his colleague, Dr. B. E. Fernow, forms an essential chapter in the history of the development of American forest policies. Associated as they were, the two minds formed an alliance in presenting forestry to a new country. It was generally assumed that at the source of every creek there was enough pine to last for all time; they were heralded as the "denudiatics." But so many of their early predictions have now become demonstrated realities that their teachings are known and accepted to-day as general truths by all.

Professor Roth rapidly achieved distinction in the bureau. His publication, "Timber," in 1895 was early recognized as a first step toward the dissemination of scientific knowledge concerning wood in America: bulletin 10 has, perhaps, been used more than any other one publication which deals with timber.

His acquaintance with the forests of the Lake States led to a study and report on "Forest Conditions of Wisconsin," 1898. This was the first publication written on the forests of that region.

Still associated with Dr. Fernow, he taught forestry at Cornell University from 1898 to 1901. Later he served as an administrator of the national forest reserves, Department of the Interior. He remained here until the urgent call for the establishment of forestry at the University of Michigan was heeded. In 1903 he organized the first courses in forestry to be given in the middle west.

With little financial assistance, he labored successfully with the newly founded and meagerly equipped department. With characteristic enthusiasm, he told his early classes of the one hundred per cent. increase in the university's equipment—"We now have two pairs of calipers." During Professor Roth's administration, the professional facilities and material equipment of the department assumed worthy proportions. No other man was better qualified than "Daddy" to establish forestry in the Lake States.

As an exceptional teacher, Professor Roth was also a worker among his boys. The last time he taught dendrology, he made a tree book for himself and con-

tinued to be a student with his students. As a lecturer, he always had a wealth of material to present and he was original in the saying. He took a leading interest in all matters pertaining to a scientific forestry and through his many publications revealed his unqualified devotion to the subject.

In addition to the many shorter publications he wrote and edited, Professor Roth was also the author of "Cypress," "The Annual Ring," "Timber Physics," "Uses of Wood," "Grazing in Forest Reserves," "First Book of Forestry," and the texts "Forest Regulation," "Forest Valuation." A revision of these texts was made soon after his retirement from the university.

His notable contributions brought him in touch with prominent men in all branches of science. In 1910 he attended the International Forestry Congress and represented the United States at Brussels. His service rendered while serving with the Michigan State Forestry Commission, the old Public Domain Commission, and later with the Conservation Commission are well known to the friends of state conservation and forestry. He was singly recognized in being selected as the honorary member, on the continent, of the Canadian Forest Engineers. In 1923 the honorary degree of LL.D. was presented to him by Marquette University.

Professor Roth was admired for his recognized ability; his friends and particularly his students will always remember him for his individual geniality. To Professor Roth we owe our appreciation for his stimulating influence in a scientific study of the American forests and forest conditions; for his initial accomplishments in forestry for the Lake States; and for his attainments in national affairs and splendid service to the entire country for his part in shaping past and future American forest policies.

DOW V. BAXTER

DEPARTMENT OF BOTANY,
UNIVERSITY OF WISCONSIN

SCIENTIFIC EVENTS

AWARDS FROM THE MILTON FUND AT HARVARD UNIVERSITY

ANNOUNCEMENT is made at Harvard University of twenty-eight awards to professors in the university in accordance with the provisions of the Milton Fund for research. As noted in SCIENCE for October 3, 1924, this legacy, yielding an annual income of about $50,000, becomes available to the university in 1924. The awards include the following for scientific work:

PERCY W. BRIDGMAN, professor of physics, for two years, to enable him to continue the services of an assistant to do the routine work of setting up apparatus and making observations in connection with his various researches on the effects of high pressure.

CHARLES THOMAS BRUES, assistant professor of economic entomology, to enable investigations to be continued on the distribution and relationships of the parasitic Hymenoptera. These insects play an important rôle in regulating the abundance of injurious insect pests, and the biological control of insect pests by this method has made rapid strides during the past two decades and bids fair to be of very great importance in the future.

EMORY LEON CHAFFEE, associate professor of physics, for two years, to pay for the services of a trained assistant and to purchase the necessary supplies to continue a research on the electrical response of the eye resulting from the stimulation of light. Work on this problem is already under way, having been assisted by a former grant from the Milton Fund.

JAMES BRYANT CONANT, associate professor of chemistry, for two years, to pay the salary of an assistant chemist and for the purpose of chemicals and apparatus to enable Professor Conant to continue his study of the irreversible oxidation of organic compounds. The purpose of the investigation is to obtain quantitative information in regard to the oxidation of organic compounds in solution at room temperature.

WILLIAM JOHN CROZIER, associate professor of general physiology, to pay the salary of a qualified assistant and for the purchase of supplies to enable an investigation to be made of the temperature characteristics of vital processes as an aid to their chemical interpretation.

SAMUEL RANDALL DETWILER, assistant professor of zoology, for a substitute teacher and for technical assistance to permit of the continuation of the research concerning nervous development in vertebrate animals, in an effort to obtain a clearer understanding of their behavior.

EDWARD WALDO FORBES, lecturer on fine arts and director of the William Hayes Fogg Art Museums, to be used to further a study of paintings by X-rays. The work is being undertaken with the cooperation of the Museum of Minneapolis, and has been assisted by a former grant from the Milton Fund.

GEORGE SHANNON FORBES, associate professor of chemistry, to purchase essential parts for the construction of apparatus to be used in special photochemical investigations. Particularly, this apparatus will be used to determine with precision the relation between photochemical reaction velocity, concentrations of reactants, wave length, intensity of light, etc. The photolysis of uranyl oxalate is finding a rapidly increasing use for the measurement of light intensity among photochemists, biologists and industrialists.

LOUIS CARY GRATON, professor of mining geology, to construct a machine for the preparation of highly perfect polished surfaces on opaque minerals and ores intended for microscopical investigation.

GRINNELL JONES, associate professor of chemistry, to permit him to continue with his researches connected with the electrical conductivity of solutions.

ARTHUR B. LAMB, Sheldon Emery professor of organic

chemistry and director of the chemical laboratory, for a competent assistant and for the purchase of minerals, chemicals, etc., in a research into the absorbent qualities of certain crystalline substances. It is expected that this work will throw considerable light on the dimensions of molecules of various gases as well as to provide a means of separating certain gases hitherto impossible of separation.

KIRTLEY F. MATHER, associate professor of physiography, to pay the salaries of a draftsman, stenographer and statistician, whose assistance is necessary for the completion of a treatise concerning the "Physiography of South America." Professor Mather has already made several trips to South America and has collected a large amount of material, which forms the subject matter of his course Geography 7—Physiography of South America. The applicant is planning to put the material into final shape for publication during the current year.

WILLIAM HENRY PICKERING, assistant professor of astronomy, *emeritus*, to defray expenses incurred in making computations and drawings in connection with Professor Pickering's researches on Mars and the Moon. During the next two years the southern hemisphere of the planet Mars will be turned toward the earth, and the work will consist largely of making astronomical observations during this period. The work will go toward the construction of a table and map similar to that now in the hands of Professor Shapley for publication in the *Annals* of the observatory.

HARLOW SHAPLEY, Paine professor of practical astronomy and director of the Harvard College Observatory, for two years, to defray expenses connected with making extensive researches which lie in the province of the variable stars. Particularly, the grant is to cover the expense of an investigation of the variability, absolute magnitudes and parallaxes of stars throughout the whole length of the Milky Way, in order to determine the distance and structure of various parts of the galactic system and thus to throw some light on its origin and growth.

WILLIAM HENRY WESTON, JR., assistant professor of botany, to complete an intensive comparative study of a group of parasitic fungi which cause the several downy mildew diseases of important food crops. Professor Weston began this work eight years ago and during this time eight papers have been published on the various phases covered. A comprehensive collection of representatives of all known fungi from various parts of the world has been made. The grant will be used for paying for the part-time services of two well-trained graduate students.

EDWIN BIDWELL WILSON, professor of vital statistics, to pay for the extra clerical assistance needed to conduct a general statistical investigation on all stars for which a large amount of material is available, in accordance with biometric methods involving partial correlation.

CONGRESSIONAL LEGISLATION ON AGRICULTURAL MATTERS

AMONG bills touching on agriculture which have been introduced in Congress are the following:

A supplemental estimate of $185,000 for the Department of Agriculture for the fiscal year 1927, to continue the research work of the fixed-nitrogen research laboratory under the Bureau of Soils, has been transmitted to the senate from the president, with an accompanying letter from the director of the Bureau of the Budget. The agricultural appropriation bill, carrying a total of $129,370,468, has been reported to the senate with amendments, by the Committee on Appropriations.

Representative Edwards, of Georgia, has introduced a bill (H. R. 9692) directing the Secretary of Agriculture to cooperate with the various cotton-producing states in investigating the "brown wilt" and other diseases of the cotton plant.

Establishment and maintenance of a forest experiment station in Porto Rico is provided for in a bill (H. R. 9595) which has been introduced by Mr. Davila, of Porto Rico.

The senate has also passed a resolution (S. Res. 146) requesting the Tariff Commission to investigate the cost of producing cream and milk, etc., at home and in competing countries.

A bill (S. 1250) amending the act authorizing donations of public lands to states and territories that provide colleges for the benefit of agriculture and the mechanical arts has been passed by the senate. It provides that income from the sale of such lands must be devoted to agricultural and industrial education.

Another bill (S. 1462) passed by the senate permits an exchange of land for the improvement of the Medicine Bow National Forest.

The first urgent deficiency bill (H. R. 8722), with amendments providing additional amounts for forest fire weather-warning surveys and for fighting and preventing forest fires, has been passed by the senate. All items in the bill affecting the Department of Agriculture have been agreed upon by the two houses.

Representative Haugen, of Iowa, has introduced a bill (H. R. 9458) to authorize the grazing of livestock on national forests, to provide for the establishment of grazing districts on the public lands of the United States and Alaska, and to regulate their beneficial use by livestock, and for other purposes.

Senator Harreld, of Oklahoma, has introduced a bill (S. 3260) "to authorize the Secretary of the Interior and the Secretary of War to lease lands for game-preserve and game-propagation purposes to state departments or other organizations under state or federal control."

THE EVOLUTION OF MAN

THE following minute has been adopted by the Council of the American Anthropological Association:

In view of the dogmatic objections raised against the theory of evolution the council of the American Anthropological Association have thought it advisable to formulate the present position of scientific inquiry.

The plants and animals belonging to early periods of the earth's history show that the forms have not remained the same for any length of time. The changes that have occurred are of such character that we are compelled to

consider the later forms as descendants of older forms. No form of living being has remained the same through the ages. The evidence of past times is corroborated by the structural and developmental analogies observed in related forms, proofs of a gradual differentiation from common ancestral forms.

The minute structure of all living matter is alike and shows that all organisms, from the lowest to the highest, must be considered as a unit.

Man has succeeded in producing a variety of forms of domestic animals and cultivated plants which differ from their ancestors. Our success, accomplished in a very short period, indicates that in long periods nature will produce more fundamental changes.

Man is part of the animal world. In all respects his anatomical structure conforms to that of the rest of the animal world. His prenatal life closely parallels that of the higher mammals. The same influences that control their development after birth control him and he responds in a like manner to the environment in which he is placed. Prehistoric archeology has shown that, in the course of the ages, man has undergone great changes in physical type and that ancient man differed from modern races, the more so the more ancient the remains.

Local types of man have developed on every continent and their existence proves that changes in the heritable characteristics of racial groups are effected in the course of time.

We must conclude that the bodily form of man as well as that of animals and plants has changed and is still changing, not in the course of centuries, but in long periods.

The exact cause of changes in the form of organisms and the conditions under which they occur, as well as the causes making for stability, are still imperfectly known. The principle of change has been so well established that it should become the common property of mankind.

THIRD PAN-PACIFIC SCIENCE CONGRESS

IN response to the invitation of the Japanese National Research Council to participate in the Third Pan-Pacific Science Congress which will be held at Tokyo, October 27 to November 9, 1926, a number of American scientific men have already decided to attend. Among these are:

President Wallace W. Atwood, Clark University, and Mrs. Atwood.

Dr. Caroline E. Furness, chairman of the department of astronomy, Vassar College, Poughkeepsie, New York.

Dr. Herbert E. Gregory, professor of geology, Yale University.

President F. S. Harris, Brigham Young University, Provo, Utah.

Dr. Andrew C. Lawson, head of the department of geology, University of California.

Dr. C. K. Leith, professor of geology, University of Wisconsin, and Mrs. Leith.

Dr. G. W. Littlehales, U. S. Hydrographic Office, Washington, D. C.

Dr. George F. McEwen, Scripps Institution of Oceanography, La Jolla, California.

Dr. George H. Parker, professor of zoology, Harvard University, and Mrs. Parker.

Rev. Father Roque Ruaño, faculty of civil engineering, University of Santo Tomas, Manila, P. I.

Dr. W. A. Setchell, head of the department of botany, University of California.

Dr. T. Wayland Vaughan, director, Scripps Institution of Oceanography, La Jolla, California.

Dr. Victor C. Vaughan, chairman, division of medical science, National Research Council, Washington, D. C., and Mrs. Vaughan.

If there are others who are planning to go to Japan for this congress next fall, it is requested that word be sent to the National Research Council, Washington, D. C., to be forwarded to the National Research Council of Japan.

SCIENTIFIC NOTES AND NEWS

THE council of the British Association for the Advancement of Science will nominate Sir Arthur Keith, Hunterian professor in the Royal College of Surgeons and secretary of the Royal Institution, as president of the association for the meeting in Leeds in 1927. At the Oxford meeting this year Professor F. O. Bower will preside over the botanical section in place of the late Dr. William Bateson.

DR. MICHAEL I. PUPIN, professor of electromechanics at Columbia University, was awarded the honorary degree of doctor of laws by the University of California on March 23, at the annual charter day exercises of the university. Dr. Pupin gave the principal address on this occasion.

DR. SIMON FLEXNER, director of the Rockefeller Institute for Medical Research, has been elected an honorary member of the Microbiological Society of Leningrad, Russia.

DR. MONTROSE T. BURROWS has been elected to succeed Dr. W. B. Cannon as chairman of the committee on protection of medical research of the American Medical Association. Expressions of appreciation were recorded by the board of trustees "for the very valuable service rendered by Dr. Cannon in the position which he held so long."

THE John Burroughs Bronze Medal will be formally presented to William Beebe, the naturalist and author, at the annual meeting of the John Burroughs Memorial Association, to be held on April 3, at 3 P. M. in the auditorium of the American Museum of Natural History.

PROFESSOR ERNEST H. WILSON, assistant director of Arnold Arboretum, has received the Veitch Memorial gold medal awarded to him by the British Royal

Horticultural Society. He is the first American to receive this honor.

JEAN CHARCOT, explorer, has been elected a member of the French Academy of Sciences in the place made vacant by the death of François-Felix Tisserand.

PROFESSOR CHARLES RICHET, emeritus professor of physiology at Paris, has recently been nominated Grand Officer of the Legion of Honour.

DR. F. A. BATHER, keeper of the department of geology, British Museum (Natural History), has been elected a foreign member of Halle Academy of Sciences.

DR. A. C. MOORE, of the University of South Carolina, was elected president of the South Carolina State Academy of Science at a meeting of the academy on March 18.

E. F. BEAN has been appointed state geologist of Wisconsin and director of the State Geological and Natural History Survey. Mr. Bean has been acting state geologist since last September, when Dr. W. O. Hotchkiss resigned the position to become president of the Michigan School of Mines. Mr. H. R. Aldrich, formerly director of field parties on the survey, has been appointed assistant state geologist.

SIDNEY PAIGE, chief of the areal geology section of the U. S. Geological Survey, has accepted an appointment with the Amerada Corporation for work in South America. W. R. Smith has resigned as geologist in the Alaska branch of the survey.

LIEUTENANT-COLONEL CHARLES F. CRAIG, Medical Corps, U. S. Army, has been appointed director of laboratories and of the department of clinical pathology and preventive medicine at the Army Medical School, Washington, D. C.

PROFESSOR GEORGE O. HIGLEY, head of the department of chemistry at Ohio Wesleyan University, has been appointed health officer of Delaware, to succeed the late Dr. Cyrus W. Chidester.

DR. F. O. ANDEREGG has resigned as associate professor of physical chemistry in Purdue University to accept the industrial fellowship on Portland cement at Mellon Institute of Industrial Research, University of Pittsburgh. T. R. LeCompte (M.S., Louisiana State) and Dr. J. J. Enright (Ph.D., Yale) have been appointed fellows of the institute. Mr. LeCompte will be engaged in research on problems in felt hat technology. Dr. Enright will carry on a biochemical-bacteriological study of dental caries, in cooperation with faculty members of the school of dentistry, University of Pittsburgh.

THORNE L. WHEELER, of Arthur D. Little, Inc., has been appointed by General Amos A. Fries as one of the consultants for the U. S. Chemical Warfare Service.

DR. E. H. SELLARDS, professor of geology in the University of Texas, has been given leave of absence in order to attend the International Geologic Congress at Madrid and to visit some localities of geologic interest in Europe.

DR. LYMAN C. NEWELL, of the department of chemistry at Boston University, has been granted a leave of absence for the next academic year which will be spent in visiting laboratories in this country and Europe.

EMERY C. LEONARD, botanist of the Smithsonian Institution, has returned from botanical exploration in the Republic of Haiti lasting four months.

PROFESSOR SAMUEL J. RECORD, of the Yale Forestry School, has returned from an absence of two and a half months spent on a collecting trip through the forests of Central America.

DR. J. M. ALDRICH, associate curator of insects in the U. S. National Museum, will leave for Guatemala, on April 1, to study and collect parasitic diptera.

DR. ROBERT CUSHMAN MURPHY, assistant director of the American Museum of Natural History, writes that the statement that he planned to go on a collecting trip to the Dutch East Indies is incorrect.

AT the University of Texas Professor Charles Schuchert has completed his service as visiting professor of geology in the graduate faculty for the winter term and will shortly return to New Haven. Professor Arthur Keith, of the United States Geological Survey, has accepted a similar appointment for the spring term of the present year and will give a course in structural geology.

SIR ARTHUR SMITH WOODWARD has left England for Beirut, Syria, where he will be engaged for the next three months in the preparation of a work on the Cretaceous fishes of Mount Lebanon.

SIR JAGADIS CHANDRA BOSE, the Indian plant physiologist, is leaving for Europe to lecture before the Academy of Sciences at Brussels, on the special invitation of the King of the Belgians. He will also lecture before British and Continental universities.

PROFESSOR ACHARD, general secretary of the Paris Academy of Medicine, is soon to leave on an official mission to visit the universities and scientific societies of Japan.

PROFESSOR THEODORE W. RICHARDS, director of the Wolcott Gibbs memorial laboratory at Harvard University, will read a paper entitled "Internal Pressures, Chemical and Cohesive, which determine the Exist-

ence of Solids and Liquids," at a meeting of the Northeastern section of the American Chemical Society to be held at the Massachusetts Institute of Technology on April 9.

THE first course of two lectures under the Morris Herzstein lectureship on diseases of the Pacific Basin, including tropical diseases, will be given by Dr. Henry S. Houghton, director of the Peking Union Medical College, at Lane Hall of the Stanford University Medical School. Monday, April 26, and Wednesday, April 28, have been tentatively selected as the dates for the lectures, which will be given at 8:00 P. M.

DR. B. BROUWER, professor of neurology at the University of Amsterdam, will deliver the seventh Harvey Society lecture at the New York Academy of Medicine on Saturday evening, April 17, on the subject of "Comparative Anatomy and Nerve Pathology."

DR. GEORGE N. STEWART, professor of experimental medicine, Western Reserve University School of Medicine, will deliver the Mellon lecture of the Biological Society at the Carnegie Institute, Pittsburgh, on April 30 on "Studies on the Adrenal Glands."

DR. R. B. SOSMAN, of the geophysical laboratory, Carnegie Institution of Washington, will give a series of ten lectures at the Massachusetts Institute of Technology during the first two weeks of April on the subject of "Elastic Waves and the Earth's Structure."

DR. S. B. WOLBACH, professor of pathology at the Harvard Medical School, addressed the scientific staff of the Rockefeller Institute for Medical Research on March 26 on "A Résumé of Rickettsia Research."

DR. EDWIN E. SLOSSON, editor of Science Service, gave an address entitled "The Chemical Interpretation of History" at a joint meeting of the Washington Academy of Sciences, the Philosophical Society of Washington and the Chemical Society of Washington on March 18.

DR. FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution of Washington, Boston, Mass., gave a lecture on March 15 before the Physiological Society of Philadelphia on "Perspiratio Insensibilis: Its Significance in Physiology and Pathology and its Relationship to Skin Temperature and Heat Loss." On March 19 this same address was given by Dr. Benedict at Teachers College, Columbia University, New York City.

DR. ALDO CASTELLANI, professor of tropical medicine at Tulane University of Louisiana Medical School, gave the Gehrmann memorial lectures at the University of Illinois College of Medicine on "Fungi as Causative Agents of Disease in the Tropics and in the Temperate Zone" on March 23, 24 and 25.

DR. JOHN C. MERRIAM, president of the Carnegie Institution of Washington, gave a lecture on March 26 before the Columbia University chapter of Sigma Xi. The subject of the lecture was "Cave Exploration in California and its Bearing upon Problems of Pleistocene History."

DR. HERBERT OSBORN, of Ohio State University, gave a lecture on "Early History of Entomology" before a joint meeting of the Agriculture Club and Gamma Sigma Delta, the honor society of agriculture, at the Alabama Polytechnic Institute during the week of March 7.

HUGH D. MISER, state geologist of Tennessee, gave an illustrated address on "Erosion in the San Juan Canyon, Utah," at the University of Cincinnati, on March 10.

PROFESSOR A. S. EDDINGTON will deliver the Bakerian lecture of the Royal Society on May 6, taking as his subject "Diffuse Matter in Inter-stellar Space." The Croonian lecture will be delivered by Professor A. V. Hill on the "Laws of Muscular Motion," on May 20. On March 4, a discussion on "The Electrical State of the Upper Atmosphere" will be opened by Sir Ernest Rutherford.

PROFESSOR ARNOLD SOMMERFELD, professor of physics at the University of Munich, delivered the first of a course of three lectures on "Atomistic Physics" at the Imperial College of Science and Technology, under the auspices of the University of London, on March 3.

DR. J. LUCIEN MORRIS, professor of biochemistry in the school of medicine of Western Reserve University, died on March 19, aged forty years.

BENJAMIN PICKMAN MANN, examiner in the United States Patent Office and at one time assistant entomologist in the U. S. Department of Agriculture, died on March 22, aged seventy-eight years.

PROFESSOR DAVID SING CAPPER, for twenty years professor of engineering in the University of London, died on February 12, aged sixty-one years.

DR. O. STOERK, professor of pathology and director of the institute for pathologic histology and bacteriology at Vienna, has died, aged fifty-six years.

AT the meeting of British botanists held in the rooms of the Linnean Society of London on March 10, it was resolved to send an invitation to the members of the fourth International Botanical Congress (Congress of Plant Sciences) meeting at Ithaca, New York, in August, 1926, to meet for the fifth International Botanical Congress, in London, in 1930.

EXERCISES installing a chapter of Sigma Xi at New York University took place on March 20. Pro-

fessor F. K. Richtmyer, head of the department of physics at Cornell University, presided and later gave the chapter its charter. Professor C. E. McClung, head of the department of zoology at the University of Pennsylvania, addressed the members. After the ceremonies a formal dinner was held in the Faculty Club. Dr. Holmes C. Jackson, head of the department of physiology and dean of the College of Dentistry, presided. Speakers were Clarence E. Davies, acting secretary of Sigma Xi; Chancellor Elmer Ellsworth Brown, Dean Marshall Stewart Brown, Dean Archibald L. Bouton, of the college of arts and pure science, Dean Charles Henry Snow, of the college of engineering, and Professor Arthur F. Hill.

DR. WM. A. FELSING, professor of chemistry at the University of Texas, visited the University of Arizona on February 18–20, and installed the Phi Chapter of Phi Lambda Upsilon. Dr. Felsing addressed the Sigma Xi Club on Thursday, February 18, on the topic "Low Temperature Research," and the following Friday he spoke before the Arizona Section of the American Chemical Society on "The Corrosion of Iron."

IN accordance with a request made by the United States Bureau of Soils and approved by the director of the budget, there has been included in the bureau's appropriation for the fiscal year 1927 an item of $185,000 which will enable the Secretary of Agriculture to continue the research work of the Fixed Nitrogen Research Laboratory under the bureau.

SAMUEL AUGUSTINE COURTAULD has given £30,000 to the Middlesex Hospital, London, for the erection of a research and training department in connection with the medical school. This is to be known as "The Courtauld Institute of Bio-Chemistry." Plans provide for a new seven-story building to be erected on a site adjacent to the Middlesex Hospital and its medical school premises. The Courtauld Institute will be a complete department of medical chemistry. In 1924 Mr. S. A. Courtauld endowed the chair of anatomy at the Middlesex Hospital Medical School with £20,000.

THE Department of Mines, Ottawa, Canada, would be grateful for any information that might lead to the discovery of Mr. Frederick W. Waugh, for many years an assistant-ethnologist on its staff. Mr. Waugh, who was in very poor health, disappeared mysteriously in Montreal on September 20, 1924, when returning from Seven Islands, on the north shore of the Gulf of St. Lawrence. It is thought possible that he may have suffered from loss of memory, and sought employment with some other scientific organization in America or Europe. In addition to ethnology, he was greatly interested in the biological sciences, and had made a close study of spiders and mushrooms; he was also an expert gardener. Mr. Waugh was born in 1872, was five feet ten inches in height, of spare build, with grey eyes, dark brown hair turning grey, and walked with a slight stoop. His native tongue was English, but he read both French and German.

A BILL has been introduced into the New York State Assembly by James R. Robinson to provide the State College of Agriculture, Ithaca, with $1,250,000, to come out of the $100,000,000 bond issue voted last fall, of which $10,000,000 is to be spent yearly. The million and a quarter was allotted to the college by an agreement between Governor Smith and the republican leaders, but the necessary legislation had not been started previously. It is planned to use the money for the construction of the plant industry building.

THE Lehn and Fink Products Company, of New York, have established at Columbia University a research fellowship for the investigation of problems in the field of essential oils, perfumes and related products, the work to be carried out in the organic laboratories under the direction of Professor Marston T. Bogert.

MONTEFIORE HOSPITAL for Chronic Diseases, New York City, announces the establishment of the Hilda Stich Stroock research fellowship with an honorarium of $1,200 a year. The fellowship may be taken in the medical, neurological, tuberculosis or cancer divisions.

ACCORDING to the London *Times*, the vice-chancellor of Cambridge University (Dr. A. C. Seward, master of Downing College), has received the following decision of the judges delegate who heard the appeal of Mr. J. B. S. Haldane on March 17 at the Royal Courts of Justice (SCIENCE, p. 298): "The majority of the court is of opinion that, in view of all the circumstances of this particular case, which have been more fully before us than they were before the vice-chancellor and the *sex viri*, the appeal should be allowed, but this decision is not to be taken as any expression of opinion that adultery may not be gross immorality within the meaning of the statute."

THE scientific expedition under Professor Matthew W. Stirling, of Berkeley, Calif., which intends to penetrate the unknown interior of Dutch New Guinea to study pigmy and other primitive tribes, will leave Java on April 4. The first party, consisting of the American members and a detachment of Dutch infantry, will sail on that day. The second party, consisting of 130 natives and two detachments of infantry, will leave Java on April 20. Dr. Hoffman, a Dutch army surgeon, and three helpers will accompany the scientists. Measures have been taken to en-

able the expedition to proceed even if an accident happens to its airplane.

AN expedition, under the auspices of the American Museum of Natural History, will leave this summer to collect specimens in Greenland. Captain Bob Bartlett, Peary's captain, will command the ship, the *Morrissey*. Knud Rasmussen, the explorer, will accompany the trip if his health permits. Arthur Young, who has shot big game in Africa and the Arctic with bow and arrows, will be a member of the party. In addition several scientific men will go with the expedition. The general advisory committee of the expedition will be composed of Harrison Williams, Junius S. Morgan and Cleveland E. Dodge, trustees of the American Museum of Natural History; Professor Henry Fairfield Osborn, president of the museum; Frederic C. Walcott, of the New York Zoological and American Geographical Societies; George H. Sherwood, of the American Museum of Natural History; Fitzhugh Green, Arctic explorer and author, and Colonel E. Lester Jones, chief of the Coast and Geodetic Survey. Pictorial records of the expedition's experience and accomplishments will be made with motion and still cameras, especially the wild life.

ACCORDING to an announcement by the U. S. Department of Agriculture, the Mexican government will send four forestry students to this country to study methods of the United States Forest Service as soon as arrangements now being negotiated by Senor Jose Alcarez, director of the Mexican forest service, and William B. Greeley, chief forester of the United States Department of Agriculture. The men being sent to this country by Mexico are from among the first graduates of the newly established forest school conducted by the Mexican government. They will pay special attention to reforestation, silviculture, forest administration and forest utilization policies and methods.

A MESSAGE from Vladivostok reports the return of the scientific expedition led by the geologist Dobrovsky in Inner Mongolia. The expedition has explored the district of the Okhrona River where large deposits of combustible clays were discovered, and the central part of Mongolia where large deposits of fossilized bones of marine animals were found. Many interesting discoveries were made by the expedition in the Gobi Desert. The work of the expedition will be resumed next year.

HONORING the state and the University of Illinois, the name "Illinium" has been given to the newly discovered chemical element No. 61 by its discoverer, Dr. B. S. Hopkins, of the department of chemistry of the University of Illinois.

THE American Society of Swedish Engineers, founded in 1888, has announced the establishment of an annual award of a gold medal for contributions to science and engineering by persons of Swedish birth or extraction. It will be known as the John Ericsson Medal, in honor of the engineer and scientist of that name.

UNIVERSITY AND EDUCATIONAL NOTES

THE University of California has announced gifts totaling approximately $2,000,000, including $1,000,000 from William Randolph Hearst for a women's gymnasium, as a memorial to his mother.

DR. JAMES NATHANIEL JENNE, Burlington, professor of clinical medicine and therapeutics at the college of medicine of the University of Vermont, has been appointed acting dean to succeed the late Dr. Henry C. Tinkham.

DR. VICTOR RAY, Sr., Cincinnati, has been appointed head of the department of ophthalmology of the University of Cincinnati College of Medicine, to succeed Dr. Robert Sattler, resigned. The trustees of the university voted unanimously to appoint Dr. Sattler, who has been head of the department since 1882, as emeritus professor of ophthalmology.

DR. GEORGE W. HUNTER, head of the department of biology at Knox College and author of the widely used text-book "Civic Biology," has resigned.

PROFESSOR CHARLES A. ISAACS, head of the department of mathematics at Washington State College, has resigned to enter business.

PROFESSOR W. W. RANKIN, head of the department of mathematics at Agnes Scott College, Decatur, Ga., has been appointed to a professorship in Duke University and will begin work there next September.

DR. A. L. MELANDER, professor of entomology at the State College of Washington and entomologist of the experiment station, has been appointed to a position at the College of the City of New York.

DR. E. C. EDGAR, head of the school of chemistry at the Polytechnic, London, has been appointed principal of the Rutherford Technical College, Newcastle.

PROFESSOR THEODOR MOLLISON, of Breslau, has been called as successor of Rudolf Martin at Munich.

DISCUSSION AND CORRESPONDENCE

SENSITIVE FLAMES

I HAVE recently happened on a means of obtaining a tall sensitive flame without using a pressure higher than that in the gas mains. The new part

of the apparatus is a bottle into which the gas from the main flows before passing to the nozzle at which it burns. With a pressure in the gas main of about 13 cm of water, a bottle of some 600 cc capacity, and a certain nozzle consisting of a piece of glass tubing drawn down at the orifice to an inside diameter of about 1.7 mm, the flame is from 60 cm to 70 cm tall, and when a high-pitched whistle is sounded or the letter *s* is spoken or keys jingled or paper crumpled, the flame responds by ducking to a height of 25 cm or 30 cm. If the bottle is taken away, the flame from the same nozzle is hardly sensitive at all.

I have examined the effects of bottles of three sizes, and of inserting between the bottle and the nozzle different lengths of rubber tubing. With a bottle which has a capacity of 250 cc the flame is less sensitive than with the 600 cc bottle, but a bottle which has a capacity of more than two liters is little, if any, better than the 600 cc bottle. When using the 600 cc bottle, putting increasing lengths of tubing between the bottle and the nozzle seems to be without effect on the sensitiveness—at any rate up to a length of about eight meters of tubing. But when using the 250 cc bottle, increasing the length of tubing between the bottle and the nozzle improves the sensitiveness—until the flame becomes as sensitive as the one from the 600 cc bottle.

This last fact suggested doing away altogether with the bottle, and simply using a long tube from the gas cock to the nozzle. This turns out to be possible. The flame begins to be sensitive before the tubing attains a length of two meters, and with several meters of tubing the flame is as sensitive as with the bottle.

The size of the orifice from which the flame burns is important. If the orifice is too small, the pressure in the mains does not bring the flame near enough to the point of flaring. If the orifice is too large, the cock has to be partly closed to prevent continuous flaring, and the flame proves not to be sensitive. The best nozzle that I have used has an orifice of such diameter that the flame is just on the point of flaring when the cock is wide open. With this nozzle the flame is sensitive without the bottle, and the bottle does not seem to add to the sensitiveness. But with another nozzle, which looks very much like the first, the cock has to be only partly open, and the difference in sensitiveness with the bottle and without it is very marked.

The possibility of obtaining a sensitive flame by the use of a bottle may have some bearing on the theory of sensitive flames. Tyndall[1] found "as an essential condition of complete success, that a free way should be open for the transmission of the vibrations from the flame, backwards, through the gas-pipe which feeds it. The orifices of the stopcocks near the flame ought to be as wide as possible." Tyndall's assistant, Mr. Barrett,[2] pointed out that the bad effect of a partly open gas cock may be obviated by "many feet of free tubing" between the cock and the nozzle, and he suggested that the partly open cock may produce a "ricochetting of the current of the gas from side to side of the pipe," thus leading at the orifice, he believed, to a narrowed stream of gas with an increased velocity. This increase in velocity he supposed would have the same effect as an increase in pressure—it would make the flame flare continuously. If Mr. Barrett's explanation were correct it would seem as if a slightly larger orifice or a further slight closing of the gas cock ought to make the flame sensitive. Very often this is not the case. Another possible cause for the bad effect of a partly open cock was suggested by Rayleigh:[3] A hissing of the gas as it passes the cock—the hiss being produced only when the cock is partly open, and the sound of the hiss being carried "to the burner along the supply-pipe acting as a speaking-tube." Rayleigh tried experiments "with various nozzles inserted in the supply-tube. These included holes in thin metal plates and drawn-out glass tubes. Even though the rubber tubes were so bent that the streams issuing from the nozzles were directed against the sides, no sound was heard, and no loss of sensitiveness was apparent." He concludes: "It would seem that mere irregularity of flow produced no marked effect, and that, provided no sound attended it, the full pressure could be borne without flaring."

If Rayleigh's explanation is correct it would hardly seem that the use of a bottle between the gas cock and the nozzle would make much difference. A hissing sound might well be considerably damped by traveling through the gas in several meters of rubber tubing, but it does not seem likely that it would be greatly damped by passing through the gas in a glass bottle. Moreover, if I connect to the cock a piece of tubing several meters long, and hold my ear close to the farther end of this tube, I find that the hiss at the cock is much dulled by transmission through the tube; whereas if I use a short piece of tubing to connect the bottle to the cock, and then hold my ear close to the opening in which I usually put the nozzle, I hear the hiss very distinctly.

Perhaps the hiss at the cock is not an important cause of the lack of sensitiveness. When an organ pipe is sounding Friedrich[4] detected vibrations which

[1] John Tyndall, *Phil. Mag.*, 33, pp. 92, 375, 1867.

[2] W. F. Barrett, *Phil. Mag.*, 33, pp. 216, 287, 1867.

[3] Rayleigh, *Phil. Mag.*, 13, p. 345, 1882.

[4] W. Friedrich, *Ann. der Physik*, 7, p. 97, 1902.

were carried back through the supply tube for a distance of ten meters. It may be that the sensitiveness of a flame requires a sufficient space through which vibrations may be carried backward in order for the incident sound to produce its effect, and that either a sufficient length of tubing or the enlargement in a bottle supplies this space, whereas a partly closed cock reflects the waves and does not give them access to the necessary space. This suggestion is at present little more than a guess, and it may be necessary to modify it when the exact mode of action of sensitive flames becomes better understood.

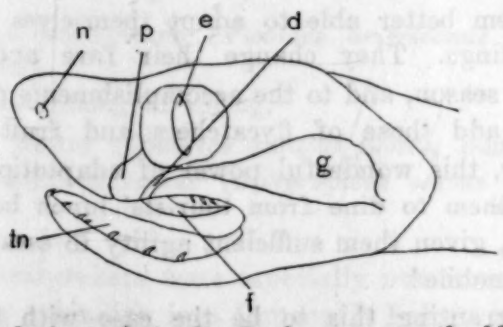
ARTHUR TABER JONES
SMITH COLLEGE

THE VENOM OF NEW-BORN COPPERHEADS

THE writer recently received from a local attorney, Mr. C. Wm. Cramer, a female copperhead snake, *Agkistrodon mokasen* Beauvois, with three young. The young were born in a glass case in Mr. Cramer's office on September 13 and 15.

When received by the writer the young were about a month old and were about 20 cm long by 1 cm in diameter at the thickest region. They were quite active and aggressive, being more inclined to strike at moving objects near them than was their mother.

When only a day old, according to Mr. Cramer, one of these young snakes struck a live mouse upon the head. Mr. Cramer left the room, at this time, and when he returned, in about five minutes, the mouse was dead. In order to test the venom of these young snakes the writer placed a half-grown rat in the small case in which they and a blacksnake were confined. The activity of the rat soon excited the young copperheads and they were not slow to strike. Several times they hit the rat, but whether their fangs penetrated the skin it was not possible to determine; no blood was seen, but as the fangs, even in these tiny snakes, were about 3 mm long and as sharp as a needle it would seem likely that they would penetrate the rat's skin. The rat, however, was apparently not affected in the least although it was kept alive until the next day.



A lateral view of the head of a one-month-old copperhead snake, after removal of the skin. Outlined with a camera lucida. ×4. *d*, curved duct of poison gland; *e*, eye; *f*, poison fang; *g*, poison gland; *n*, nostril; *p*, pit; *tn*, tongue sheath on floor of mouth.

A few days later the young snakes were killed and skinned for mounting. At this time one or two of the poison glands, which were very large in proportion to the size of the snake, as is seen in the accompanying figure, were removed and were ground in a small quantity of normal salt solution. This solution was then hypodermically injected into several very young rats which were about half the size of an adult house mouse. None of these tiny rats showed any effect from the injection, though they were kept until the following day.

A poison gland was removed from one of the young copperheads and mounted for histological study. Its microscopic structure was apparently the same, except for differences caused by size, as that of the several adult glands with which it was compared, but there was little or no secretion to be seen in the alveoli. Of course the amount of secretion found in sections of adult poison glands varies in different individuals, but I have never seen an adult gland entirely devoid of secretion. Possibly if other of these young glands could have been sectioned they would have been found to contain secretion.

It would seem from the absence of injury to the half-grown rat from repeated attacks by the new-born copperheads; from the absence of any effect from the subcutaneous injection of crushed gland into very young rats; and from the apparent absence of secretion from the only gland microscopically examined that new-born copperheads, in spite of relatively very large fangs and poison glands, are not capable of poisoning other animals.

In the case of the mouse killed in Mr. Cramer's office it is possible that during Mr. Cramer's short absence from the room the adult copperhead may have struck the mouse, although he is sure that such was not the case. I have seen a mouse die almost instantly from the bite of a 30 cm rattlesnake.

Possibly some reader of SCIENCE may have made some more conclusive observations upon the age at which the pit-vipers acquire their power of injecting venom.

ALBERT M. REESE
WEST VIRGINIA UNIVERSITY

GRADUATE WORK IN HORTICULTURE[1]

GRADUATE students who are interested in horticulture are not now compelled to take their graduate work in closely allied subjects, especially botany. They can take it in horticulture directly, since sev-

[1] Published with consent of Director of Experiment Station.

eral departments of horticulture in the state and agricultural colleges of the United States are offering work leading to the degree of doctor of philosophy.

This change is to be commended, provided the students who desire this graduate training are properly prepared for it. Unless they are required to lay a good foundation through work in fundamental subjects during their undergraduate days, the problem of transforming them into real masters of science and doctors of philosophy in horticulture is very gigantic, if not impossible. As yet it can not be asserted that they measure up to expectations. Data have been taken on twenty-five graduate students in the agricultural division at the Michigan State College. Sixteen of them were in horticulture, the remainder in various other departments. Three were graduates from Canada, while twenty-two of them possess diplomas from the various agricultural colleges in ten different states of the Union. The record is given in the accompanying table.

Undergraduate Work of 25 Graduate Students

Subject	No. of semester hours credit			
	None	5 or less	6 to 12	12 or more
Logic	24	1		
Philosophy	25			
German	19	3	2	1
French	18		7	
College Mathematics	7	5	10	3
College Physics	9	5	9	2
College Chemistry			10	15

The data are very interesting. These students were adequately prepared in chemistry alone. Thirty-six per cent. had had no college physics and twenty per cent., five hours or less in that subject. Twenty-eight per cent. had not taken any college mathematics, while twenty per cen.t had taken five hours or less. Seventy-two per cent. of them knew no French, while those without German were seventy-six per cent. of the entire number. As to logic and philosophy, their preparation was nil. Furthermore, it was learned by personal inquiry that these same students were almost wholly deficient in the sphere of general cultural reading and had spent their entire time while undergraduates in taking purely practical subjects in their several fields.

Clearly, they were greatly handicapped in their ambition to do graduate work. It may even be conjectured that they were not fitted in the best way for life and success in the world of everyday activity. It is possible, with the exception of logic and philosophy, which are seldom, if ever, offered in agricultural and state colleges, for graduate students to take these subjects after registration in the graduate school, but is this the best plan to follow? It seems not. Instead, they should be free to devote all their time to their investigations and to the task of reading deeply and thoroughly into the extensive literature which may bear upon science in general and their own research problems in particular.

What is the remedy? Two or three suggestions may be ventured. Perhaps the academic requirements respecting fundamental subjects for graduation from our agricultural colleges might be increased to some extent without too great a diminution of the strictly practical necessities. Horticultural faculties might place more emphasis on fundamental subjects, especially in advising any undergraduate students showing ability and inclination for advanced study. A third thing which might be more potent than any other measure would be the creation of an atmosphere more conducive to scholarly effort and a profound attitude regarding the proposition of realizing a college education. With such an atmosphere in existence in an institution of higher learning it would probably be possible to require students to take at least two years' work in the more general and fundamental subjects before being permitted to enter classes in the branches of applied knowledge where they wish to major. This would be better than having them enter these classes before they have acquired any knowledge to be applied, as is now the case in most instances.

John W. Crist

Michigan State College,
East Lansing, Mich.

IS THE AUTOMOBILE EXTERMINATING THE WOODPECKER? COMMENT.

In the issue of Science for January 15, 1926, Professor Homer R. Dill, of the University of Iowa, makes the query, "Is the automobile exterminating the woodpecker?" and presents some very interesting data, which would indicate that one species (the red-headed woodpecker) has habits which put it at a distinct disadvantage to its motorized environment in Iowa. Of this species Chapman[1] states: "Indeed few birds seem better able to adapt themselves to their surroundings. They change their fare and habits with the season, and to the accomplishments of woodpeckers add those of flycatchers and fruit-eaters." However, this wonderful power of adaptation which enables them to dine from tourists' lunch boxes has not, alas, given them sufficient agility to escape from the automobile!

But, granting this to be the case with the red-headed, are woodpeckers in general in such danger?

In northern New York and New England, at least,

[1] Chapman, Frank M., "Handbook of Birds of Eastern North America," Revised, 1919, p. 328.

where the writer is familiar with conditions, no dead woodpeckers have ever been noted along highways during several seasons of motoring; no doubt some collide with wires, etc., but the writer is not aware of any case where the automobile was at fault. Observations here would indicate that permanent residents of the woodpecker family shun highways, and that abundant food exists for them in the deep forest. The northern flicker and yellow-bellied sapsucker frequent orchards and the outskirts of town, but have not been observed in danger from traffic. The red-headed woodpecker is practically non-existent in this region, having been seen in northern New York only once by the writer, and that many years ago. Were it present in such numbers as in Iowa, it might run into the same danger.

Far from being in peril of extermination, woodpeckers in northern New England should be on the increase. The reasons for this belief are based on the following observations: (1) The great abundance of insect food available because of the devastation caused by the spruce budworm (*Cacoecia umiferana,* Clem.) in northern New England and eastern Canada during the last fifteen years and the accompanying bark beetle infestations; (2) there is every reason to believe that the natural enemies of woodpeckers are being preyed upon to an equal, if not greater, degree than woodpeckers themselves; (3) the great numbers of woodpeckers which are encountered in the forest.

During the winter and spring of 1925, spent in the forest in northwestern Maine, opportunity was presented to study the daily life of several species at close hand. The following species, present almost daily about the camp porch, are listed in the order of their relative abundance.[2]

Hairy woodpecker (*Dryobates villosus villosus,* Linn.).
Downy woodpecker (*Dryobates pubescens medianus,* Swains).
Pileated woodpecker (*Phloeotomus pileatus pileatus,* Linn.).
Arctic three-toed woodpecker (*Picoides arcticus,* Swains).
Three-toed woodpecker (*Picoides americanus americanus,* Brehm).

and, with the coming of spring,

Northern flicker (*Colaptes auratus luteus,* Bangs).
Yellow-bellied sapsucker (*Sphyrapicus varius varius,* Linn).

Hairy woodpeckers were especially numerous. On a peninsula extending into Cupsuptic Lake a conservative estimate would place the number at two to three birds per acre, eagerly at work upon insect-infested spruce and balsam fir, as well as upon paper birch attacked by the bronze birch borer (*Agrilus anxius,* Gory.). One was practically never out of earshot of the pileated woodpecker, chiselling for carpenter ants at the base of some balsam—although seen less frequently on account of his shyness. Individuals of all species were unusually plump and well-nourished. No stomach examinations were made, but fragments of bark which littered the ground suggested that Pitykteines, Ips, Dendroctonus, Monochamus and many other genera were included in their food.

Following the nesting season many of the young made their appearance at the feeding station; they were exceptionally fat creatures, not differing appreciably in size from their parents. While no counts were made of the number of young per brood, there is every reason to believe that the abundance of food led not only to an unusually large "crop" of young, but also reduced the mortality during the nesting stage.

In conclusion, it is the writer's impression that the automobile can not be said to be exterminating woodpeckers in the northeast. Woodpeckers are forest birds, and while some few of the 375-odd species of Picidae may become adapted to life in telegraph poles in settled regions, and enjoy the benefits and hazards of civilization, the greater number will retreat to the deep woods with the advent of man and cultivation. A much more potent enemy of the woodpecker than the automobile is the disappearance of high forests, and especially coniferous forests. And, finally, the encouragement of woodpeckers should be every one's concern, for they are some of our very best forest protectors.

HENRY I. BALDWIN
BROWN COMPANY RESEARCH LABORATORIES,
BERLIN, NEW HAMPSHIRE

[2] The nomenclature is based on Chapman, *loc. cit.*

HUMAN TAILS—A STATEMENT AND A CORRECTION

THERE is a very extensive literature on human beings with tails, and there are a considerable number of absolutely authentic cases.

In the Johns Hopkins *Bulletin* Vol. XII, 1901, p. 96, Dr. Ross G. Harrison has published a case and has appended quite a full bibliography. In some cases the tail has been amputated and microscopical examinations have been made showing enough muscular tissue to enable them to be moved. In other cases the existence of rudimentary vertebrae with fully formed joints between them lined with a synovial membrane has been shown.

In *Nature,* 1921, Vol. 106, p. 845, Sir Arthur Keith, the eminent curator of the museum of the Royal College of Surgeons of England, has discussed the embryological evidence for such tails. He writes me that

"some years ago we got a very good specimen of a human tail for the museum."

Professor A. H. Schultz, of the Carnegie Institution of Washington (Jl. Washington Academy of Science, June 19, 1925), publishes from the *Scientific American* (1889, p. 296) a photograph of a human being with a tail nine inches long.

So much for a brief statement as to the actual existence of human beings with tails.

The correction I wish to make is as follows: In my book "I Believe in God and in Evolution," I have included in the fourth edition a photograph of an Igorot with a tail, which I vouched for as I understood that it had been photographed by my own grandson, Mr. John Freeman.

A few days ago within a few hours of each other, I received letters from Dr. Aleš Hrdlička, of the division of physical anthropology of the National Museum of the Smithsonian Institution, and Mrs. Ella F. Grove, who a year ago had been doing some work in the Philippines for the National Research Council. Both of these correspondents stated that the Bureau of Science in Manila had shown them the original of this photograph which showed that it was a fake photograph, the tail having been added to the original by a photographer, I suppose as a joke.

On communicating with my grandson I find that I misinterpreted his letter and that he did not photograph this Igorot.

My argument that human tails (of which I have shown there are very many undoubted instances) prove our animal ancestry is not in the least disproved by my having unfortunately used a photograph which further investigation has shown to be a fraud, for there are plenty of genuine tails.

My whole object is to state the truth, and when any statement I have made is proved to be wrong, I wish to be the very first person to disclose the error.

Dr. Hrdlička adds "As to the occurrence of tails of course I am with you in every particular."

W. W. KEEN

SCIENTIFIC BOOKS

THE EVOLUTION CONTROVERSY

Evolution not Irreligious. Some General Aspects of Evolution and its Relations to Religion. By WALTER C. KRAATZ, Ph.D., assistant professor of biology, University of Akron, Ohio. Published by the author, price 20 cents.

DR. WALTER C. KRAATZ, of Akron, Ohio, sets out to show that "evolution is not irreligious" by "paying respects above all to Nature, for she is the fundamental teacher."

"Nothing is outside the domain of natural law and the Infinite at the basis of it. There is everywhere change. The Universe is not static in any of its parts." This statement is illustrated by features of cosmic evolution, geological evolution, biological evolution and historic development or evolution in human history, while the finely graded artifacts of stone-age man is but "a pushing back into pre-history and a demonstration of evolution."

Next our author takes up the various features of organic evolution, the present battle ground of attack by enemies of science. Organic evolution is defined by Dr. Kraatz as "gradual development from the simplest primordial matter on earth through modifications or changes to the many diverse sorts or organisms of to-day." The process of descent with modification is again compared with the growth of a tree, the analogies being numerous and striking. The various stages in life are briefly but accurately stated. He concludes that "we are not descended from a monkey or even an ape of any present-day type. Those apes and monkeys we know are living, altered forms. They are our contemporaries, and not in any way possibly in our ancestral lines. Apes and man had a common ancestry. Geologically that was not tremendously long ago . . . it was certainly not more than half a million years ago."

As to varied views of species forming, Dr. Kraatz is non-committal. He omits, however, all mention of isolation with segregation, a condition which acts everywhere along with selection, and without which, so far as we know, neither artificial selection nor natural selection could accomplish permanent results.

The present divergent views as to species forming are largely due to the failure of observers and experimenters to grasp each others' point of view, and to coordinate their results. Truth is always consistent with itself, but facts incompletely understood may seem to point in different directions.

In the third chapter Dr. Kraatz insists that there can be no conflict between the search for objective truth and the emotion or attitude of religion, which rests on no objective facts. The so-called "fundamentals of religion" have no natural or necessary relations to it. Historically they are additions or incrustations devised to promote religious feeling, or to be parasitic upon it. Of either of these we may find plenty of illustrations.

The Tennessee Evolution Case. By ROBERT S. KEEBLER, of the Memphis, Tennessee, Bar. Printed by "Friends of Fair Play," Memphis, Tennessee.

ROBERT S. KEEBLER, a leading attorney of Memphis, has taken up arms against the Tennessee law, its origin and its effects, in spirited fashion. He says of the statute itself:

This was no dull, cold, lifeless act of a sort which make the law a dismal science. It flashed lightning and rolled thunder. Hailed by some as a signal triumph if the Christian faith as against the atheistical tendency of science, by others as clear ecclesiastical tyranny and a recrudescence of the Inquisition, and by still others as a triumph of asininity which would defeat its own aim, the law attracted the attention and provoked the opinions of lawyers, scientists, ecclesiastics and teachers throughout the nation.

This discussion from the legal standpoint is noteworthy because the case is clearly stated, and because the Tennessee Bar Association, before which it was read, meeting at Memphis, officially rebuked the author because he "instead of being confined to the legal question discussed a religious issue."

But the point of his discourse lay in the fact that the force of law had been invoked in the interest of opinions claiming to be "religious."

Keebler claims that the "anti-evolutionist law" is unconstitutional on the following grounds:

(1) It violates the sacred duty imposed by the Constitution of the state of Tennessee upon the legislature to cherish science.

(2) It violates our constitutional guaranty of religious freedom.

(3) It violates our constitutional guaranty of intellectual freedom.

(4) It violates the fourteenth amendment of our federal constitution.

(5) In so far as our university is concerned, it violates a solemn contract between the state of Tennessee and the United States of America.

In an eloquent closing paragraph this idea is stressed; "We may know that whatever rubbish of the centuries is penetrated in this irrepressible quest after truth, the essential verities will remain."

DAVID STARR JORDAN

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SACCARDO'S "SYLLOGE FUNGORUM"

WHENEVER the history of botany is passed in review one of the outstanding monuments of patient comprehensive industry will be found always in the classified enumeration of the known fungi of the world, inaugurated and carried as near to completion as the term of a lifetime permitted, by the late Professor P. A. Saccardo, of Padua.

Like the comparable work of Linnaeus, his "Sylloge" seems destined to be continued in a series of supplements and revisions for many years before a successor is launched. As was true of his great Swedish precursor, Saccardo will incur much criticism for the artificiality of a classification suited to the state of knowledge of his time rather than expressing relationship, that ought never to obscure the value of his organized compendium to other branches of science and particularly to the new science phytopathology of which it forms an essential foundation stone.

After a dozen years, a twenty-third volume of the "Sylloge" has been given out under the authorship of Professor Trotter, of Portici. This constitutes the tenth general supplement to the work—and includes additions to Basidiomycetes in the broad sense which includes rust and smut fungi in this group. To descriptions of these, 950 large octavo pages are devoted; host- and name-indexes adding seventy-six pages more.

A special feature of this volume is a list of eighteen biographic sketches of Saccardo; and an enumeration of 238 publications by this distinguished Italian botanist whose interests were not at all closely limited to the field of mycology.

Tribute is paid by the editor to numerous workers whose studies have contributed to the present knowledge of fungi—grouped by countries; and in addition to the Americans included in this list it is to be noted that the late Professor Farlow, of Harvard University, and Professor Stevens, of the University of Illinois, receive special recognition in the preface.

WILLIAM TRELEASE

UNIVERSITY OF ILLINOIS

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

THE Secretary of the International Commission on Zoological Nomenclature has the honor to announce the publication of Opinions 82 to 90 rendered by the International Commission on Zoological Nomenclature by the Smithsonian Institution in Smithsonian Miscellaneous Collections, volume 73, number 3, pages 1 to 40. The summaries read as follows:

Opinion 82. Suspension of Rules for *Musca* Linnaeus, 1758a, Type *M. domestica*.—By authority of the power conferred on the Commission by the 9th International Congress of Zoology to suspend the Règles as applied to any given case where in its judgment the strict application of the Règles will clearly result in greater confusion than uniformity, Article 30 is hereby suspended in the case of *Musca* Linnaeus, 1758, and *Musca domestica* Linnaeus, 1758, is hereby designated as type of *Musca* without prejudice to other cases.

Opinion 83. *Acanthiza pyrrhopygia* Vigors and Horsfield, 1827, versus *Acanthiza pyrrhopygia* Gould, 1848.—The principle of the Rule of Homonyms is that any properly published identical name of later date is "stillborn and can not be brought to life." *Acanthiza pyrrhopygia* Vigors and Horsfield, 1827, invalidates *Acanthiza pyrrhopygia* Gould, 1848.

Opinion 84. *Trematode, Cestode,* and *Acanthocephala*

Names placed in the Official List of Generic Names.—The following names are hereby placed in the Official List of Generic Names: *Trematoda: Dicrocoelium, Fasciola, Gastrodiscus, Heterophyes. Cestoda: Davainea, Dipylidium, Echinococcus, Taenia. Acanthocephala: Gigantorhynchus.*

Opinion 85. Ninety-eight Generic Names in Crustacea placed in the Official List of Generic Names.—The following names are hereby placed in the Official List of Generic Names: *Crustacea: Acmaeopleura, Asthenognathus, Bathyplax, Camptandrium, Camptoplax, Catoptrus, Ceratoplax, Chasmagnathus, Chasmocarcinus, Clistocoeloma, Cyrtograpsus, Dissodactylus, Durckheimia, Epixanthus, Euchirograpsus, Eucrate, Eucratodes, Eucratopsis, Euryetisus, Euryplax, Eurytium, Fabia, Galene, Geryon, Glyptograpsus, Glyptoplax, Gomeza, Goneplax, Halimede, Helice, Hephthopelta, Hexapus, Holometopus, Holothuriophilus, Homalaspis, Lachnopodus, Leptodius, Liagore, Libystes, Liomera, Lipaesthesius, Litocheira, Lophopanopeus, Lophopilumnus, Lybia, Melybia, Metasesarma, Metopocarcinus, Micropanope, Notonyx, Oediplax, Ommatocarcinus, Opisthopus, Orphnoxanthus, Panoplax, Paragalene, Parapanope, Parapleurophrycoides, Paraxanthus, Percnon, Perigrapsus, Pilumnoides, Pilumnus, Pinnaxodes, Pinnixa, Pinnotherelia, Pinnotheres, Planes, Platychirograpsus, Platypilumnus, Platyxanthus, Polydectus, Prionoplax, Pseudocarcinus, Pseudopinnixa, Pseudorhombila, Psopheticus, Ptychognathus, Pyxidognathus, Rhithropanopeus, Rhizopa, Ruppellioides, Sarmatium, Scalopidia, Scleroplax, Speocarcinus, Sphaerozius, Tetraxanthus, Tetrias, Thaumastoplax, Utica, Varuna, Xanthasia, Xanthodius, Xenophthalmodes, Xenophthalmus, Zosimus, Zozymodes.*

Opinion 86. *Conulinus* von Martens, 1895.—The generic name *Conulinus* von Martens, 1895, takes as type *Buliminus* (*Conulinus*) *convlus* Rv., and is not necessarily invalidated by *Conulina* Bronn.

Opinion 87. The Status of Proof-Sheets in Nomenclature.—Printer's proof-sheets do not constitute publication and, therefore, have no status under the International Rules of Zoological Nomenclature.

Opinion 88. *Otarion diffractum* vs. *Cyphaspis burmeisteri.*—The name of a species is not disqualified merely because the author included in his conception bodily parts of more than one species. The name of a genus based on such a species is therefore available. *Otarion diffractum* Zenker is valid. *Otarion* is to be preferred to *Cyphaspis*, and *C. burmeisteri* Barr. is a synonym of *O. diffractum.*

Opinion 89. Suspension of the Rules in the Case of Gronow 1763, Commerson 1803, Gesellschaft Schauplatz 1775 to 1781, Catesby 1771, Browne 1789, Valmont de Bomare 1768 to 1775.—Under suspension of the rules, in any case where such suspension may be considered necessary according to the interpretation now or hereafter adopted by the Commission, the following works or papers are declared eliminated from consideration as respects their systematic names as of their respective dates: Gronow 1763, Commerson 1803, Gesellschaft Schauplatz 1775 to 1781, Catesby 1771, Browne 1789, Valmont de Bomare 1768 to 1775.

Opinion 90. Report on Sixteen Generic Names of Mammals for Which Suspension of Rules was Requested.—None of the sixteen names receives a unanimous vote for suspension; accordingly, the Commission is not emnames (namely: *Cercopithecus, Gazella, Hippotragus, Lagidium, Nycteris,* and *Manatus*) receive two thirds majority or more for suspension, and are, therefore, to be referred for final decision to a special committee of three to be appointed by the president of the section on nomenclature of the next international congress. Ten names (namely: *Echidna, Anthropopithecus, Coelogenys, Chiromys, Dasypus, Dicotyles, Galeopithecus, Hapale, Rhytina* and *Simia*) fail to receive a two thirds majority vote for suspension, and therefore the Law of Priority is to be applied in these cases.

C. W. STILES, *Secretary.*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A BLACK COLLODION COATING FOR ATMOMETER SPHERES

MANY of those engaged in the study of the influence of evaporation upon plants, insects, and so forth, have need for black atmometer spheres, used in conjunction with similar white spheres for indicating the possible influence of solar radiation upon rates of water loss. A supply of satisfactory black spheres has not yet been secured, although ceramic experiments are in progress toward that end. It is therefore still necessary to employ superficially blackened spheres. A method for blackening white spheres with washed lampblack has been described (SCIENCE 58: 182–183, September, 1923), but spheres blackened in this way require to be reblackened after each rain and after each cleaning. Another and recently developed method for superficially blackening white spheres is to lay over the spherical surface a thin collodion film bearing lampblack. The collodion-coated spheres have proved very satisfactory. Their preparation is described below.

Collodion solution (Merk's "Reagent" or "U. S. P., No. 9") is employed, with sufficient lampblack mixed into it to produce a thoroughly opaque, black film when the sphere is dipped in the liquid. It is well to moisten the lampblack first with a little alcohol, to make a paste, which can then be easily and uniformly dispersed throughout the collodion solution. There should be no air bubbles in the mixture, which needs finally to be thinned by addition of ether.

Regular white atmometer spheres with their necks waterproofed are dipped in the black liquid, so as to coat thoroughly the whole spherical surface, care being taken to avoid air bubbles that might lie between the porcelain and the coating. Upon lifting

the sphere from the liquid, the excess of the latter is allowed to drop off, after which the sphere, held by the cylindrical neck, is swung to and fro through the air, being rotated by wrist movement and turned in such a manner as to distribute the collodion as equally as possible over the surface. This treatment rapidly removes some of the alcohol-ether solvent and the black membrane gels. But drying must not go too far. As soon as the membrane has hardened slightly, the sphere is dipped again and the process is repeated. Generally three dippings are found to be best. Some experimentation is requisite to secure the right dilution of the liquid and the right manipulation. After the last treatment and before drying proceeds too far, the blackened sphere is placed under distilled water, to be kept so till it is to be mounted for use.

Collodion-coated spheres may be preserved under water and may be shipped from place to place in sealed pint "Mason" jars, a wrapping of wet filter paper being first applied, to prevent the membrane from coming into contact with the glass wall of the jar. If several layers of wet filter paper are used the jar need not be completely filled with water, but it is generally best to have it full, the sphere cavity being also filled.

The water-impregnated collodion-lampblack membrane will bear a surprising amount of rubbing and it may be cleaned from time to time in the operation of the instrument, by sponging with distilled water and an absorbent-cotton or soft-cloth swab. The membrane is not apt to be injured in ordinary handling. It should never be allowed to dry, for the gel alters on losing its imbibed water and the process is practically irreversible.

The coefficient of correction for a collodion-coated sphere may be slightly different from that for the same sphere before being coated. A blackened and a standardized white sphere placed side by side, in the open preferably and equally exposed to air currents, are read for a night period to secure information as to the coefficient of the blackened one. Both instruments are set after dark in the evening and they are read before sunrise the following morning. The loss from the white sphere is multiplied by its regular coefficient (as hundredths) and the product thus secured is divided by the corresponding loss from the blackened sphere. The quotient is the coefficient of the latter, by which its readings are to be multiplied.

It is doubtless true that the collodion film considerably diminishes the capacity of the sphere wall to transmit water from the supply within to the external evaporation surface, and it naturally follows that evaporation and sunshine conditions may at times be encountered so intense as to surpass the capacity of the coated instrument. But the conducting capacity of the collodion membrane (which should not be unnecessarily thick) appears to be ample for all evaporation and solar-radiation intensities apt to be encountered, excepting perhaps in the most arid climates. This possible difficulty has not yet been experienced, however. The collodion-coated spheres may of course be tested by comparison with similar spheres blackened with washed lampblack by the water method. The latter have proved suitable for the driest hours in the most arid regions. The two forms absorb radiation about equally.

The method here described provides black spherical atmometers that do not lose their coatings when exposed to rain. They can be easily kept clean by occasional wiping with distilled water and a soft swab. With collodion-coated spheres no mercury valve is necessary to prevent absorption of rain and dew. Neither of these desirable features is possessed by spheres blackened with lampblack and water.

Since mistakes may occur, we may add that a general summation of the evaporation conditions is secured from the white instrument alone, which absorbs but little radiation, and that the difference between corresponding corrected losses from the white sphere and from the black is an indication of the radiation influence. Total sunshine intensity, integrated throughout the period of observation, is nearly proportional to the difference just mentioned, as far as the influence of solar intensity upon evaporation from this sort of instrument is concerned. The combination of a blackened and a white sphere operated side by side and thus constituting a radio-atmometer is the most satisfactory means thus far available for measuring the total intensity of sunshine in ecological and physiological studies.

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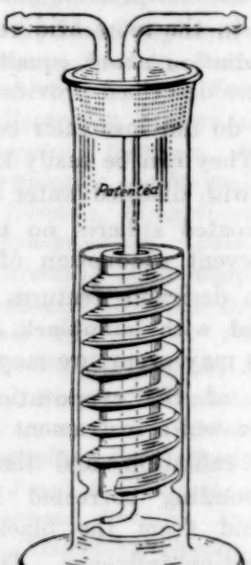
A NEW SPIRAL GAS-WASHING BOTTLE

A NEW spiral gas-washing bottle has been designed in order to meet severe requirements. The new bottle gives excellent contact for a long time between the gas and a definite volume of liquid so that there is good opportunity for complete absorption or saturation of the liquid with gas; the liquid is thoroughly circulated so that all of it is brought into contact with the gas; there are no dead spaces to trap any of the gas.

The bottle consists of four parts, which are rugged and can easily be taken apart for cleaning: an outer

cylinder (1), a cylindrical shield (2) fitting loosely into the outer cylinder and serving to support and fit closely to a heavy inner cylinder (3) the walls of which are pressed in the form of a spiral, and a gas inlet tube (4) integral with a ground-glass stopper and outlet tube. The bottle is filled with liquid up to just above the top of the spiral. The inlet tube serves to introduce the gas at the base of the spiral, and the gas bubbles travel slowly upward circling around the spiral in contact with the liquid until



they escape at the surface. The liquid circulates upward with the bubbles and then downward both through the center of the spiral and around the outside of the shield.

The important features of this bottle have been patented, and it is now available, of American manufacture, fitted with either a ground-glass stopper or a rubber stopper, under the name "Milligan gas-washing bottle."

LOWELL H. MILLIGAN

SPECIAL ARTICLES

SOME FEATURES OF STRUCTURE AND BEHAVIOR IN VAMPYRELLA LATERITIA[1]

DURING the past fall colonies of *Spirogyra Weberi* harboring numerous individuals of *Vampyrella lateritia* were obtained. The manner of feeding of this animalcule is such as to produce repeatedly and in almost precisely the same manner a surgical operation on individual cells of *Spirogyra*—upon which it feeds exclusively, as has long been known—of utmost nicety. Inasmuch as the behavior of the protoplast of the plant had a distinct bearing on certain other behaviors during its conjugation (Lloyd, 1924, 1926), I paid a good deal of attention to the matter and incidentally learned several things about the animal which, officially, I had no right to learn.

Vampyrella has been regarded as homaxial (Hoogenraad).[2] When viewed from above the animal is spherical during free movement, but some facts indicate that it has anterior-posterior polarity. If a central vacuole is present, this is not symmetrically situated. During movement forward the center of the vacuole is behind the topographical center of the animal, and kept thus, albeit the antero-posterior axis suffers oscillations. This movement is produced by long slender pseudopodia, the longest of which project much further than thought by Hoogenraad (1907), namely, about three diameters, and the laterally projecting ones always display characteristic curvatures, there being in each a delicate knee-like bend evidently produced by the strains attending ambulation. Aside from pseudopodia used in walking, long ones extend out in all directions while doing so.

On attacking a *Spirogyra* cell the apposing surface of the animal flattens, long pseudopodia are extended along the algal filament, and, becoming quite amoeboid, he spreads partly around the doomed cell. The long pseudopodia generally disappear (Hoogenraad), only short ones, often pin-headed, clothing the free surface. Within a minute or so the transverse walls of the attacked cell begin to bend gradually inward. By the time the limit of this buckling is reached, the animal suddenly swells. This results from the injection of algal cell contents into the animal through an oval opening effected by digestion of the cellulose (Cienkowski[3]). The stretching of the attacked area of the wall during the earlier period of hydrolysis relieves the turgor pressure—hence the bending inwards of the cell wall—due to the now superior pressure of the neighboring cells. The final bursting outwards of the hydrolyzed piece of wall permits the sudden blowing up of the animal and at the same time the punctured cell is disarticulated. As soon as the turgor pressure is relieved, the animal begins to actively suck out the protoplast. Adhesion of the algal cytoplasm to the wall prevents its ready displacement, but the chloroplast is much more rapidly drawn out. Within one and a half minutes after the hole has been made, the whole chloroplast swells and becomes

[1] Identification based on Leidy's description. "Fresh water Rhizopods of North America," Rep. U. S. Geol. Surv. of the Territory," *12*: (253–256) 1879.

[2] Hoogenraad, H. R., "Einige Beobachtungen an Vampyrella lateritia Leidy," *Arch. f. Protistenkunde*, *8*: 216–224, 1907.

[3] Cienkowski, L., "Beitrage zur Kenntniss der Monaden," Archiv. f. mik. Anat. *1*: 203 (218–221, pl. 12–14) 1865.

tubular. During conjugation there is exerted tension on the male chloroplast, but since this does not cause swelling it may be inferred that the response to the animal follows contact with some substance or substances derived either from the animal itself or from the surrounding medium. Similar swelling, for example, results from the ingress of salts or from undue pressures. After the chloroplast has been partially withdrawn, the "primordial utricle" follows, but rather reluctantly, and the animal has evidently considerable to do to get it all out. Sometimes he takes up a new stance, extending pseudopodia in new directions for anchorage and thus readdressing himself to the task. These in part may be under pull; others seem to push, but I think act merely as guys. The whole of the ingested material is received into a central, correspondingly enlarging vacuole, and at the close of a course, the animal is considerably swollen. But being a voracious beast, a single course does not satisfy him; he now moves off to another cell and repeats the operation, which occupies about twenty minutes or less, as Hoogenraad also noted. I have watched an animal devour four *Spirogyra* cells one after the other. The volume of a single cell being about ten times the original volume of the animal, one sees that he ingests about forty times his volume, most of which is water. But he does not get forty times as big. In fact he can be observed during a few minutes to decrease materially in volume, and, when five minutes after the end of the last courses, he finds himself plethoric and disposed to rest, perchance to sleep and dream, and settles down to encystment, his volume is little greater than it was at first. Inasmuch as *Vampyrella* has been supposed not to have contractile vacuoles, I wondered by what mechanism the water was got rid of. It could hardly be assumed that the animal has no semipermeability. On watching closely an individual just after he had come to rest for encystment, I found, contrary to the previously held view, (Hertwig and Lesser,[4] Hoogenraad) that he has not one, but many quite, but not uniformly small contractile vacuoles. I watched a large number of these form *within the hyaline margin, and burst*. Hertwig and Lesser saw them, but state that they are non-contractile. Having once seen them I found them without difficulty in the motile condition of the animal. They are so numerous and small that they readily escape notice, but it seems certain that their combined action is rapid and efficient enough to rid the animal of unneeded water at a high rate. The whole procedure is extraordinarily like that in the gametes of some species of *Spirogyra* during conjugation, *e.g.*, *S. maxima*, especially when the process is somewhat slow. During feeding, especially if the animal is plethoric, there usually occur vigorous spasmodic contractions accompanied by the ejaculation of excreta (presumably). This arises as a dense cloud of granules floating for a short space above the surface of the animal. The setting free of granules of this sort in fewer numbers takes place more or less constantly and irregularly. One pictures what happens correctly if he sees many vacuoles contracting and expelling their contents at once—possibly a special kind of minute vacuole containing excreta.

After the contents of the *Spirogyra* cell attacked have passed into the receptive vacuole, the chloroplast rapidly shrinks into denser rounded masses and these are now taken into food vacuoles by moving toward the periphery of the animal into his cytoplasm. The central vacuole meanwhile disappears. A fully fed animal is crowded with masses of the green chromatophores and the less visible protoplasm of the alga. The former retain their color for a long time (Hoogenraad states the contrary) their digestion occupying several days. While the masses of food are reduced in size, the containing vacuoles remain of their original dimensions, becoming spherical only, evidently containing sap of some concentration.

The oval resting animal—in the sense of Hertwig and Lesser—is covered by two membranes (Cienkowski) one immediately investing him, of some thickness and rigidity, the other (velum) hanging loosely like a veil and serving to fasten the whole to an algal filament. Both of these membranes afford the cellulose reaction, not the inner merely, as stated by Cienkowski.

In the resting condition the deep orange granules appear to increase in numbers; at all events the color of the animal becomes much deeper and richer. The pigment would seem to be carotin—Cienkowski and West[5] thought it due to the nature of its food—and to be in solution in an oil in minute vacuoles. It is not soluble in water, but it is in alcohol. It is not in crystalline condition. I attempted to get the spectrum, but failed, the amount of pigment in a single animal being too small to avail.

I can confirm Cienkowski's statement that this *Vampyrella* is very knowing in regard to the quality of the contents of the *Spirogyra* cell. He may settle down for a moment on an empty cell, but he soon rejects it. He sucks cells, but he prefers them fresh.

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[4] Hertwig, R., and Lesser, E., "Uber Rhizopoden U. S. W.," Archiv. f. mik. Anat. *10*: sup. 35 (61–65) 1874.

[5] West, G. S., "On Some British Freshwater Rhizopods and Heliozoa," *Journ. Linn. Soc. Zool.*, *28*: 308–342 (333) pl. 28–30, 1900–1903.